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THE IRRIGATION AGE

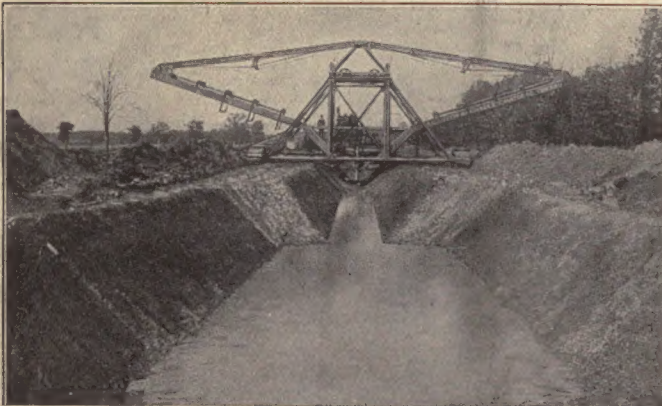
VOL. XXVII

TITLE REGISTERED U.S. PATENT OFFICE

NO. 1

CHICAGO, NOVEMBER, 1911

TIME AND PRACTICAL OPERATION



Ditch Being Dug with Sloping Banks—An Austin Drainage Excavator Ditch, showing variations in width made by same machine

prove that ditches dug with sloping banks by the

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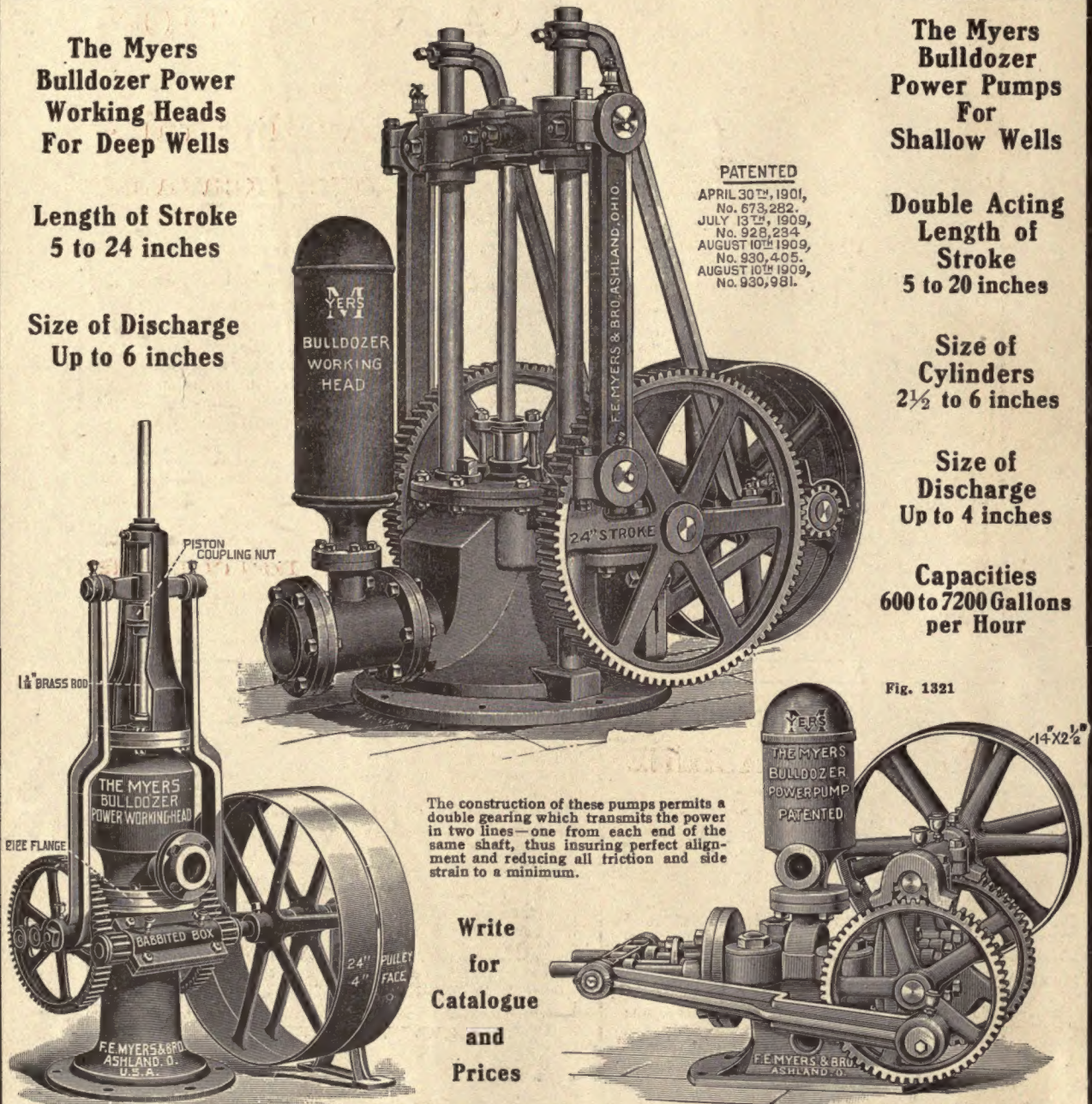
Size of
Discharge
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Capacities
600 to 7200 Gallons
per Hour

PATENTED

APRIL 30TH, 1901,
No. 673,282.
JULY 13TH, 1909,
No. 928,234
AUGUST 10TH 1909,
No. 930,405.
AUGUST 10TH 1909,
No. 930,981.

Fig. 1321



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There is no INCUMBRANCE of any kind upon this Property.

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This Property is part of the renowned "Rio Grande Valley," adjacent to El Paso, Texas. Any one wishing to visit and make an examination of the land and the improvements will be shown every courtesy.

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For further information and other particulars call on or address:

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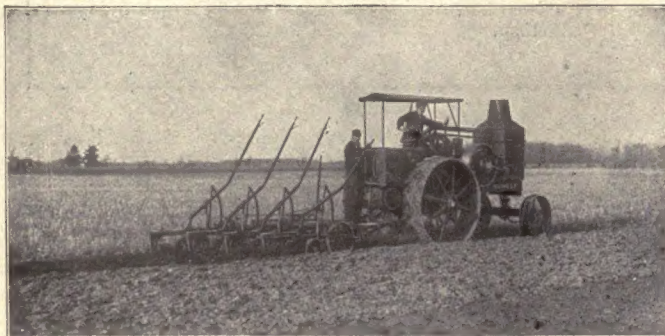
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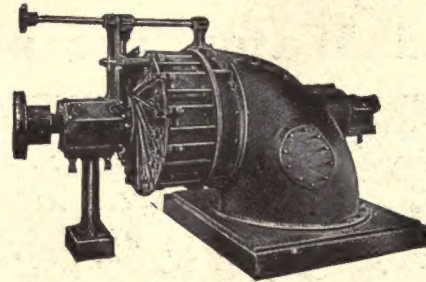
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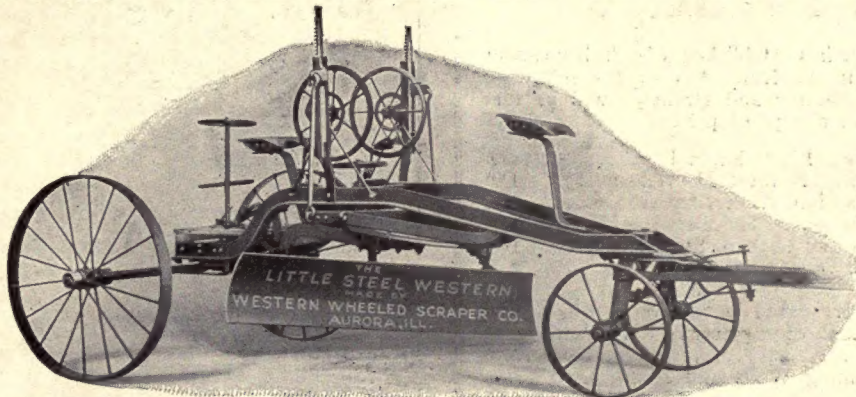
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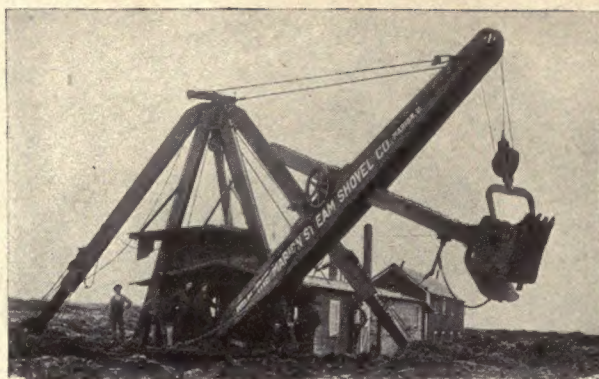
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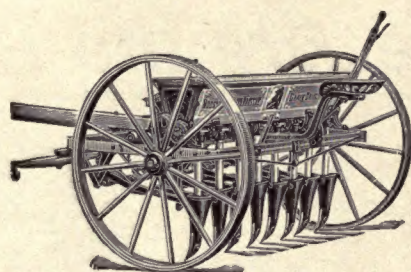
Books on Irrigation and Drainage

The *Irrigation Age* has established a book department for the benefit of its readers. Any of the following named books on Irrigation and Drainage will be forwarded, postpaid, on receipt of price:

Irrigation Institutions, Elwood Mead.....	\$1.25
Irrigation Engineering, Herbert M. Wilson.....	4.00
The Primer of Irrigation, Anderson.....	2.00
Irrigation and Drainage, F. H. King.....	1.50
Irrigation for Farm and Garden, Stewart.....	1.00
Irrigating the Farm, Wilcox.....	2.00
Practical Irrigation, Aug. J. Bowie.....	3.00
Practical Design of Irrigation Works, W. G. Bligh	6.00
Irrigation (as a branch of engineering), Hanbury	
Brown	5.00
Earth Slopes, Retaining Walls and Dams, Chas.	
Prelini	2.00
Road Preservation and Dust Prevention, Wm. P.	
Judson	1.50
Practical Farm Drainage, Chas. G. Elliott.....	1.50
Drainage for Profit and Health, Waring.....	1.00
Farm Drainage, French.....	1.00
Land Drainage, Miles.....	1.00
Tile Drainage, Chamberlain.....	.40
Cement Pipe & Tile, Hanson.....	1.00
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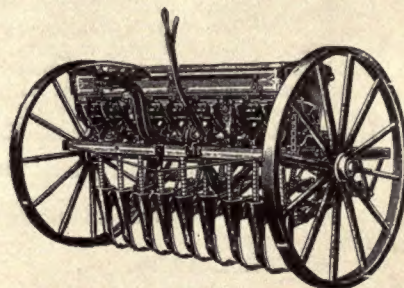
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Twenty-seventh Year

THE IRRIGATION AGE

VOL. XXVII

CHICAGO, NOVEMBER, 1911.

No. 1

THE IRRIGATION AGE

With which is Merged

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THE IRRIGATION ERA
ARID AMERICA

THE DRAINAGE JOURNAL
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THE FARM HERALD

D. H. ANDERSON

PUBLISHER,

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Old No. 112 Dearborn St.

Entered as second-class matter October 3, 1897, at the
Postoffice at Chicago, Ill., under Act of March 3, 1879.

D. H. ANDERSON, Editor

ANNOUNCEMENT.

"The Primer of Irrigation" is now ready for delivery. Price,
\$2.00. If ordered in connection with subscription, the price is \$1.50.

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To United States Subscribers, Postage Paid, . . . \$1.00
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America. D. H. Anderson, Secretary.

Official organ of the American Irrigation Federation.
Office of the Secretary, 212 Boyce Building, Chicago.

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It may interest advertisers to know that The Irrigation Age is the
only publication in the world having an actual paid in advance
circulation among individual irrigators and large irrigation corpo-
rations. It is read regularly by all interested in this subject and has
readers in all parts of the world. The Irrigation Age is 27 years
old and is the pioneer publication of its class in the world.

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The

Primer of

Hydraulics

Nearly Ready.

The "Primer of Hydraulics," which has
been published monthly in installment in
the columns of THE IRRIGATION AGE for the
past year, will be completed early in 1912,
there being another installment in the
December, 1911, issue. All our readers
are acquainted with this most valuable addition to the very
limited literature on the subject of hydraulics and cannot
help to see the great help such a book will be to the practical
irrigator or hydraulic engineer. The time is at hand when
the successful irrigator must have a knowledge of hydraulic
principles and must know how to apply them, and the "Primer
of Hydraulics" gives this information in a simple and pro-
gressive method.

It begins with the very simplest operations in arithmetic,
algebra, geometry and physics and carries the student along
from one principle to another until all are mastered that
enter into the solution of the problem.

Perhaps the most important feature of the book is that
a large number of practical problems have been worked out
as a guide for those who have similar problems to solve,
thus making the book doubly valuable as it stands always
ready to show the way how irrigation and hydraulic prob-
lems are to be analysed, and how to check the results.

The book contains a large number of valuable tables,
most of which are entirely new and have never been pub-
lished. They will prove a boon to all those who will use
the book as it reduces the work of solving problems to a
minimum.

Our Twenty- Seventh Anniversary.

With this issue THE IRRIGATION AGE enters upon its twenty-seventh year of activity, as the representative journal of irrigation and its allied branches. The steady growth in the business of our paper during this period proves that the subject of irrigation is growing and developing rapidly and that THE IRRIGATION AGE is still leading the advance in the true progress of this important art.

It is marvelous to observe the great strides made forward in the reclaiming of the arid lands during the last quarter of a century, and the tremendous value added to the cultivated lands in the United States by these means. Yet it is hard to forecast in how much greater measure this advance will take place in the immediate future as all our past experience points out a way in which to avoid mistakes and pitfalls and how to obtain best results along explored lines.

THE IRRIGATION AGE grasps the present opportunity to again announce its policy to its readers and patrons that it will stand in the future as in the past for the best interest of the irrigation and reclamation interests and that it will continue in collecting in its columns such information as is of interest and value in this direction.

It will not only disseminate knowledge along the practical lines on irrigation, drainage, dry farming and other proper lines of activity to our readers, but will also watch that justice will be done and fair play shown to the interests trying to develop lands which are now either too wet or too dry, and it will further expose any attempts made to interfere with the proper growth of irrigation, no matter from what source this interference originates. It is the intention of the publisher to continue to improve THE IRRIGATION AGE along conservative lines, to give its readers the best and most important news of the day, and to give every reader an opportunity to profit by the experience of others and to have others profit by his experience; for this purpose THE IRRIGATION AGE has opened up a correspondence department during the past year of which any reader may make use, either to impart or to request information along lines pertaining to reclamation and its applied branches.

Thus as we enter upon our twenty-seventh year of activity we earnestly ask our readers and friends to co-operate with us in making our paper more newsy, more instructive and thus more valuable; we would especially ask our friends who are, so to speak, at the front, who are building the reservoirs and head gates and ditches, and those who are applying the water to their orchards and fields, to write THE IRRIGATION AGE their experience. Irrigation is a comparatively new art, and so every man practicing it should be observant of the results under the different conditions under which the work is being done; such observations made in the field are of the highest value to the practical men and should be made public so as to make the information available for others who are working along similar lines—and THE IRRIGATION AGE is the logical channel through which such knowledge should flow to the practical irrigator among whom our circulation is greater than all other irrigation papers combined.

One word about our advertisers: The manufacturers of farming and irrigation machinery are so closely connected with the prosperity of farming and irrigation that it is absolutely necessary that there be a medium where the irrigator can meet the manufacturer and get acquainted with the tools and appliances designed to make his work easier, more satisfactory and enable him to do it quicker. This medium

is the advertising columns of THE IRRIGATION AGE, which travel to all the countries of the globe, where they are read by those who are in need of such tools and appliances and thus prove a boon to the irrigator and manufacturer alike, telling the one where to obtain what he needs and the other where there is a market for his appliances.

The Forthcoming Irrigation Congress

The time for the convention of the National Irrigation Congress is drawing near, the nineteenth session of which will be held in Chicago from December 5th to December 9th of this year. It is therefore quite fitting that we should draw the attention of our readers to this event, which is a subject of great importance and vital interest to all concerned in the reclamation of waste land, whether the reclaiming is done by irrigation, drainage or dry farming.

Many of our readers will be delegates to the Congress and will come to Chicago to participate in the activities of the convention and carry home with them many new ideas which they will imbibe by listening to the experience of other delegates and to the addresses and lectures by experts in irrigation, drainage, dry farming and forestry.

It is expected that many foreign delegates will attend the Congress and reports from them will be of especial interest, since the progress in irrigation has been quite marvelous all over the world, so much so that many splendid improvements introduced have as yet not been published, but will be brought to the attention of the Congress by special papers and lectures.

Everything seems to point to a very large and successful meeting; the officers at the head of the Congress are men of the highest type with a great deal of experience in organization; and Chicago is by all means the best and most available locality for such a gathering, as it is a central point and a terminus for all railway lines north, east, south and west, and particularly well adapted as a place where the irrigator can meet the manufacturer, since the great Coliseum will be filled with products of the shop as well as the farm and orchard.

There is still another point which should be considered seriously, and that is the "back-to-the-land" movement. There are thousands of families in the larger cities who are looking for an opportunity to cut loose from the shop and factory if they had proper information as to how to get about it. It must not be inferred that such city people are without resources, for most of them have saved money and are now looking for a safe place where they may invest in order to prepare for themselves a home and means of making a quiet and pleasant living during the declining years of their lives. Here is where the Irrigation Congress can do a great deal of missionary work during its coming convention, conferring benefits alike to the overcrowded cities and to the communities in the irrigated belts. It will tend to restore the equilibrium in population, since the last decade has increased the number of city people at a much greater ratio than the rural population, as has been shown by the last census.

THE IRRIGATION AGE will be especially active during the time the Congress is in session to gather in all the information and news possible and publish same in future issues, so that those of our readers who are unable to attend in person will in a measure obtain the benefit of the proceedings of the convention by reading them in the columns of the IRRIGATION AGE.

**Carey
Act Is
Not a
Revenue Law.**

An important ruling has recently been made by Judge Dietrich of the Federal Court in the District of Idaho, the effect of which will be that reclamation matters can be decided in state courts providing the Supreme Court will sustain the above decision.

The case calling forth this issue was that of the Twin Falls Canal Co., Limited, versus Joseph C. Foote and Chas. N. Foster and others, which was thrown out of the federal court into the state courts for adjudication, Judge Dietrich giving the following seven reasons for so doing:

"First—Unquestionably the reclamation act is not a measure for 'raising revenue' in the constitutional sense.

"Second—It is clear, and there is no decisive ruling to the effect, that the phrase 'revenue laws,' as used in section 643, is more comprehensive than the constitutional clause, 'bills for raising revenue.'

"Third—However that may be, 'revenue law,' as the phrase is ordinarily understood, does not aptly describe the reclamation act; it does not readily or naturally fall into line with the defendant's view. Construction is required.

"Fourth—There is nothing either in the history of section 643 or in the conditions conducing to its enactment from which it is to be inferred that congress intended to attach to the phrase, 'revenue law,' any unusual significance or give to it a meaning beyond that which it is ordinarily understood to convey.

"Fifth—The reported cases are wholly indecisive of the question.

"Sixth—There is nothing in the reclamation act from which it can be inferred that congress intended it as a revenue measure or from which the presumption arises that congress proposed that controversies like the one here involved should be brought within the exclusive cognizance of the federal court.

"Seventh—In view of these several considerations it is concluded generally that the reclamation act cannot properly be a 'revenue law' within the meaning of section 643. The question may not be entirely free from doubt, but we are admonished that in cases where our jurisdiction is subject to substantial doubt it should not be exerted."

As the case will be carried to the United States Supreme Court it will be of interest to watch further development. This subject will be followed closely by THE IRRIGATION AGE and full information concerning it given to its readers.

**A Decimal
System of
Measures
and Weights.**

Elsewhere appears an article by Frederick A. Smith, suggesting a new System of Measures and Weights for the United States. When one compares our present labor-wasting system with the simple decimal system outlined by Mr. Smith,

the wish appears readily that such a change be made at the earliest possible moment.

The metric system is evidently making no progress in this country, probably on account of the fact that its adoption would mean a total change in all units and would cause a tremendous upheaval in all lines of business.

The system outlined by Mr. Smith retains our present mile as the fundamental unit, and its adoption will therefore not interfere with the geographical surveys of our country nor with the subdivisions of the public lands, townships and sections remaining intact as they are at present.

It seems rather queer how a country which prides itself of having invented and using more labor-saving machinery than any other nation in the world continues to waste millions of dollars annually in time by hanging

onto an obsolete system of measures and weights, just because it takes some effort and confusion to make a change.

Much of the blame rests with our prominent educators, who, from their better knowledge of the subject, know what a benefit it would be to the country if a decimal system of measures and weights would be adopted; yet they make no effort of any importance, and the consequence is that the country remains in bondage to a burdensome and time-devouring system.

When shall we be delivered from this bondage?

**Table of
Contents
For Volume
Twenty-Six.**

This issue of THE IRRIGATION AGE contains an alphabetical table of contents of all the editorials and articles which have appeared in the columns of THE IRRIGATION AGE during the past year. This is another improvement added by the publisher as it will increase the value of the files of the paper, since any article can be readily located by examining this index. Thus step by step our paper adopts improvements for the convenience of our patrons, keeping not only a choice class of interesting and instructive reading matter, but making it easily accessible for ready reference by an approved system of indexing.

Our patrons understand the attitude of the publisher who stands for progress and fair play and this accounts for the generous support which is bestowed upon all sides to our publication. It is the intention to not only continue the good work, but to improve the same as opportunity may point the way.

Send Three Dollars for one year's subscription to THE IRRIGATION AGE and one copy of the "Primer of Hydraulics," which will be ready early in 1912. This will save you 50 cents, as the book will sell for \$2.50 net.

**Thoughts
That
Come
and Go.**

President Taft's 13,000-mile trip through the United States has given him some ideas on the Reclamation Problem.

* * *

Some of the late floods in Colorado are teaching the lesson that the weather man cannot be depended on and that it is best to be prepared for all kinds of emergencies.

* * *

THE IRRIGATION AGE enters into its twenty-seventh year with this issue, and is accordingly able to vote.

* * *

Renew your subscription promptly; the publisher must meet his bills promptly, and he will be unable to do so unless his bills receivable are paid when due.

* * *

The "Primer of Hydraulics" will be ready in January, 1912. The price of the book will be \$2.50 net, cloth bound, or \$3.00 if order is sent either with a renewed subscription or with a new subscription to THE IRRIGATION AGE for one year.

* * *

The Irrigation Congress will hold forth in Chicago, December 5th to 9th inclusive. This is to be an important meeting.

DO IT NOW

Send one dollar for a year's subscription to the Irrigation Age. Once a subscriber always a subscriber.

Surface Water Supply of the Lower Mississippi Basin*

By W. B. Freeman and R. H. Bolster.

These investigations of stream flow are not complete nor do they include all the river systems or parts thereof that might purposefully be studied. The scope of the work is limited by the appropriations available. The field covered is the widest and the character of the work is believed to be the best possible under the controlling conditions. The work would undoubtedly have greater scientific importance and ultimately be of more practical value if the money now expended for wide areas were concentrated on a few small drainage basins; but such a course is impossible because general appropriations made by Congress are applicable to all parts of the country. Each part demands its proportionate share of the benefits.

It is essential that records of stream flow shall be kept during a period of years long enough to determine within reasonable limits the entire range of flow from the absolute maximum to the absolute minimum. The length of such a period manifestly differs from different streams. Experience has shown that the records for some streams should cover from five to ten years, and for other streams twenty years or even more, the limit being determined by the relative importance of the stream and the interdependence of the results with other long-time records on adjacent streams.

In the performance of this work an effort is made to reach the highest degree of precision possible with a rational expenditure of time and a judicious expenditure of a small amount of money. In all engineering work there is a point beyond which refinement is needless and wasteful, and this statement applies with especial force to streamflow measurements. It is confidently believed that the stream-flow data presented in the publications of the Survey are in general sufficiently accurate for all practical purposes. Many of the records are, however, of insufficient length, owing to the unforeseen reduction of appropriations and consequent abandonment of stations. All persons are cautioned to exercise the greatest care in using such incomplete records.

Records have been obtained at more than 1,550 different points in the United States, and in addition the surface water supply of small areas in Seward Peninsula and the Yukon-Tanana region, Alaska, have been investigated. During 1909 regular gaging stations were maintained by the Survey and cooperating organizations at about 850 points in the United States, and many miscellaneous measurements were made at other points. Data were also obtained in regard to precipitation, evaporation, storage, reservoirs, river profiles, and water power in many sections of the country and will be made available in the regular surface water-supply papers and in special papers from time to time.

The results contained in this volume are requisite to meet the immediate demands of many public interests, including navigation, irrigation, domestic water supply, water power, swamp and overflow land drainage, and flood prevention.

Navigation.—The Federal Government has expended more than \$250,000,000 for the improvement of inland navigation, and prospective expenditures will approximate several times this amount. It is obvious that the determination of stream flow is necessary to the intelligent solution of the many problems involved.

Irrigation.—The United States is now expending \$51,000,000 on federal irrigation systems, and this amount is far exceeded by the private expenditure of this nature in the arid West. The integrity of any irrigation system depends absolutely on the amount of water available. Therefore investigations of stream flow in that portion of the country are not only of first importance in the redemption of the lands, but constitute an insurance of federal and private investments.

Domestic Water Supply.—The highest use of water

is for domestic supply, and although this branch of the subject is of less direct federal interest than the branches already named, it nevertheless has so broad a significance with respect to the general welfare that the Federal Government is ultimately and intimately concerned.

Water Power.—The development of the water power of the country is an economic necessity. Our stock of coal is being rapidly depleted and the cost of steam power is increasing accordingly. Industrial growth, and as a consequence the progress of the United States as a nation, will cease if cheap power is not available. Water power affords the only avenue now open. When the electric transmission of power was accomplished the relation of our water powers to national economy changed entirely. Before the day of electric transmission water power was important only at the locality at which it was generated, but it has now become a public utility in which the individual citizen is vitally interested. Inasmuch as the amount of water power that may be made available depends on the flow of rivers, the investigation of flow becomes a prerequisite in the judicious management of this source of energy.

Drainage of Swamp and Overflowed Lands.—More than 70,000,000 acres of the richest land in this country are now practically worthless or of precarious value by reason of overflow and swamp conditions. When this land is drained it becomes exceedingly productive and its value increases many fold. Such reclamation would add to the national assets at least \$700,000,000. The study of run-off is the first consideration in connection with drainage projects. If by the drainage of a large area into any particular channel that channel becomes so gorged with water which it had not hitherto been called upon to convey that overflow conditions are created in places where previously the land was not subject to inundation, then drainage results merely in an exchange of land values. This is not the purpose of drainage improvement.

Flood Prevention.—The damage from floods in the United States probably exceeds on the average \$100,000,000 annually, and in the year 1908, according to estimates based on reliable data, the aggregate damage approximated \$250,000,000. Such an annual tax on the property of great regions should be reduced in the orderly progress of government. It goes without saying that any consideration of flood prevention must be based on a thorough knowledge of stream flow, both in the contributing areas which furnish the water and along the great lowland rivers.

The order of treatment of stations in any basin in these papers is downstream. The main stem of any river is determined on the basis of drainage area, local changes in name and lake surface being disregarded. After all stations from the source to the mouth of the main stem of the river have been given, the tributaries are taken up in regular order from source to mouth. The tributaries are treated the same as the main stream, all stations in each tributary basin being given before taking up the next one below.

The exceptions to this rule occur in the records for Mississippi River, which are given in four parts, as indicated above, and in the records for large lakes, where it is often clearer to take up the streams in regular order around the rim of the lake than to cross back and forth over the lake surface.

Definition of Terms.

The volume of water flowing in a stream—the “run-off” or “discharge”—is expressed in various terms, each of which has become associated with a certain class of work. These terms may be divided into two groups: (1) Those which represent a rate of flow, as second-feet, gallons per minute, miner's inches, and run-off in second-feet per square mile, and (2) those which represent the actual quantity of water, as run-off in depth in inches and acre-feet. They may be defined as follows:

“Second-foot” is an abbreviation for cubic foot per second and is the rate of discharge of water flowing in a stream 1 foot wide, 1 foot deep, at a rate of 1 foot per second. It is generally used as a fundamental unit from which others are computed by the use of the factors given in tables of equivalents.

“Gallons per minute” is generally used in connection with pumping and city water supply.

*Abstract of Water Supply Paper 276, U. S. Geological Survey, 1909.

The "miner's inch" is the rate of discharge of water that passes through an orifice 1 inch square under a head which varies locally. It is commonly used by miners and irrigators throughout the West, and is defined by statute in each state in which it is used.

"Second-feet per square mile" is the average number of cubic feet of water flowing per second from each square mile of area drained, on the assumption that the run-off is distributed uniformly both as regards time and area.

"Run-off, depth in inches on drainage area," is the depth to which the drainage area would be covered if all the water flowing from it in a given period were conserved and uniformly distributed on the surface. It is used for comparing run-off with rainfall, which is usually expressed in depth in inches.

"Acre-foot" is equivalent to 43,560 cubic feet, and is the quantity required to cover an acre to the depth of 1 foot. It is commonly used in connection with storage for irrigation work.

Explanation of Tables.

For each drainage basin there is given a brief description of general conditions covering such features as area, source, tributaries, topography, geology, conditions of forestation, rainfall, ice conditions, irrigation, storage, power possibilities, and other special features of importance or interest.

For each regular current-meter gaging station are given in general, and so far as available, the following data: Description of station, list of discharge measurements, table of daily gage heights, table of daily discharges, table of monthly and yearly discharges and run-off. For stations located at weirs or dams the gage-height table is omitted.

In addition to statements regarding the location and installation of current-meter stations the descriptions give information in regard to any conditions which may affect the constancy of the relation of gage height to discharge, covering such points as ice, logging, shifting conditions of flow, the backwater; also information regarding diversions which decrease the total flow at the measuring section. Statements are also made regarding the accuracy and reliability of the data.

The discharge-measurement table gives the results of the discharge measurements made during the year, including the date, name of hydrographer, width and area of cross section, gage height, and discharge in second-feet.

The table of daily gage heights gives the daily fluctuations of the surface of the river as found from the mean of the gage readings taken each day. At most stations the gage is read in the morning and in the evening. The gage height given in the table represents the elevation of the surface of the water above the zero of the gage. All gage heights during ice conditions, backwater from obstructions, etc., are published as recorded, with suitable footnotes. The rating is not applicable for such periods unless the proper corrections to the gage heights are known and applied. Attention is called to the fact that the zero of the gage is placed at an arbitrary datum and has no relation to zero flow or the bottom of the river. In general, the zero is located somewhat below the lowest known flow, so that negative readings shall not occur.

The discharge measurements and gage heights are the base data from which rating tables, daily discharge tables, and monthly discharge tables are computed.

Field Methods of Measuring Stream Flow.

There are three distinct methods of determining the flow of open-channel streams: (1) By measurements of slope and cross section and the use of Chezy's and Kutter's formulas; (2) by means of a weir or dam; (3) by measurements of the velocity of the current and of the area of the cross section. The method chosen depends on the local physical conditions, the degree of accuracy desired, the funds available, and the length of time that the record is to be continued.

Slope Method.—Much information has been collected relative to the coefficients to be used in the Chezy formula, $v=c\sqrt{Rs}$. This has been utilized by Kutter, both in developing his formula for c and in determining the values of the coefficient n which appear therein. The results obtained by the slope method are in general only roughly approximate, owing to the difficulty in obtaining accurate

data and the uncertainty of the value for n to be used in Kutter's formula. The most common use of this method is in estimating the flood discharge of a stream when the only data available are the cross section, the slope as shown by marks along the bank, and a knowledge of the general conditions. It is seldom used by the United States Geological Survey.

Weir Method.—Relatively few stations are maintained at weirs or dams by the United States Geological Survey. Standard types of sharp-crested and broad-crested weirs within the limits for which accurate coefficients have been experimentally obtained give very accurate records of discharge if properly maintained. At practically all broad-crested weirs, however, there is a diversion of water either through or around the dam, usually for the purpose of development of water power. The flow is often complicated and the records are subject to errors from such sources as leakage through the dam, backwater at high stages, uncertainty regarding coefficient, irregularity of crest, obstructions from logs or ice, use of flashboards, old turbines with imperfect ratings, and many others depending on the type of development and the uses of the diverted water.

In general records of discharge at dams are usually accurate enough for practical use if no others are available. It has been the general experience of the United States Geological Survey, however, that records at current-meter gaging stations under unobstructed channel conditions are more accurate than those collected at dams, and where the conditions are reasonably favorable are practically as good as those obtained at sharp-crested weirs.

Velocity Method.—Streams in general present throughout their courses to a greater or less extent all conditions of permanent, semi-permanent, and varying conditions of flow. In accordance with the location of the measuring section with respect to these physical conditions, current-meter gaging stations may in general be divided into four classes—(1) those with permanent conditions of flow; (2) those with beds which change only during extreme high water; (3) those with beds which change frequently, but which do not cause a variation of more than about 5 per cent of the discharge curves from year to year; and (4) those with constantly shifting beds. In determining the daily flow different office methods are necessary for each class. The field data on which the determinations are based and the methods of collecting them are, however, in general the same.

Great care is taken in the selection and equipment of gaging stations from determining discharge by velocity measurements, in order that the data may have the required degree of accuracy. They are located, as far as possible, at such points that the relation between gage height and discharge will always remain constant for any given stage. The experience of engineers of the Geological Survey has been that permanency of conditions of flow is the prime requisite of any current-meter gaging station when maintained for several years unless funds are available to cover all changes in conditions of flow. A straight, smooth section without cross currents, backwater, boils, etc., at any stage is highly desirable, but on most streams is not attainable except at the cost of a cable equipment. Rough, permanent sections, if measurements are properly made by experienced engineers, taking measuring points at a distance apart of 5 per cent or less of the total width, will, within reasonable limits, yield better results for a given outlay of money than semi-permanent or shifting sections with smooth, uniform current. So far as possible stations are located where the banks are high and not subject to overflow at high stages and out of the influence of tributary streams, dams, or other artificial obstructions which might affect the relation between gage height and discharge.

A gaging station consists essentially of a gage for determining the daily fluctuations of stage of the river and some structure or apparatus from which discharge measurements are made, usually a bridge or cable.

The two factors required to determine the discharge of a stream past a section perpendicular to the mean direction of the current are the area of the cross section and the mean velocity of flow normal to that section.

In making a measurement with a current meter a

number of points, called measuring points, are measured off above and in the plane of the measuring section at which observations of depth and velocity are taken. (See Pl. I, A.) These points are spaced equally for those parts of the section where the flow is uniform and smooth and

regular bottoms and even flow of current. Measurements by the float method are made as follows: The velocity of flow of the stream is obtained by observing the time which it takes floats set free at different points across the stream to pass between two range lines about 200 feet apart. The area used

is the mean value obtained from several cross sections measured between the two range lines. The chief disadvantages of this method are difficulty in obtaining the correct value of mean area for the course used and uncertainty regarding the proper coefficient to apply to the observed velocity.

The Price current meter is now used almost to the exclusion of other types of meters by the United States Geological Survey in the determination of the velocity of flow of water in open channels, a use for which it is adapted under practically all conditions.

Plate II shows in the center the new type of penta-recording current meter equipped for measurements at bridge and cable stations; on the left the same type of meter is shown equipped for wading measurements, to record by the acoustic method; on the right the meter is shown equipped to record electrically. (See Pl. I, B.) Briefly, the meter consists of six cups attached to a vertical shaft which revolves on a conical hardened steel point when immersed in moving water. The revolutions are indicated electrically. The rating, or relation between the velocity of moving water and the revolutions of the wheel, is determined for each meter by drawing it through still water for a given distance at different speeds and noting the number of revolutions for each run. From these data a rating table is prepared which gives the velocity per second of moving water for any number of revolutions in a

given time interval. The ratio of revolutions per second, to velocity of flow in feet per second is very nearly a constant for all speeds and is approximately 0.45.

Three classes of methods of measuring velocity with current meters are in general use—multiple-point, single-point, and integration.

The two principal multiple-point methods in general use are the vertical velocity curve and 0.2 and 0.8 depth.



Plate 1A. Showing Method of Measuring Cross Section of River.

are spaced unequally for other parts according to the discretion and judgment of the engineer. In general the points should not be spaced farther apart than 5 per cent of the channel width, nor farther apart than the approximate mean depth of the section at the time of measurement.

The measuring points divide the total cross section into elementary strips at each end of which observations of depth and velocity are made. The discharge of any elementary strip is the product of the average of the depths at the two ends times the width of the strip times the average of the mean velocities at the two ends of the strip. The sum of the discharges of the elementary strips is the total discharge of the stream.

Depths for the determination of the area are usually obtained by sounding with the current meter and cable. In rough sections or swift current an ordinary weight and cable are used, particular care being taken that all observations shall be in the plane of the cross section.

Two methods of determining the velocity of flow of a stream are in general use—the float method and the current-meter method.

The float method, with its various modifications of surface, sub-surface, and tube or rod floats, is now considered obsolete in the ordinary practice of the United States Geological Survey. The use of this method is limited to special conditions where it is impracticable to use the current meter, such as in places where large quantities of ice and debris which may damage the meter are flowing with the current, and for miscellaneous measurements or other work where a high degree of accuracy is not necessary. Tube floats are very satisfactory for use in canals with



Plate 1B. Electric Recording Current Meter.

In the vertical velocity curve method a series of velocity determinations is made in each vertical at regular intervals, usually about 10 to 20 per cent of the depth apart. By plotting these velocities as abscissas and their depths as ordinates and drawing a smooth curve among the resulting points, the vertical velocity curve is developed. This curve shows graphically the magnitude and

mination of coefficients for purposes of comparison and to measurements under ice.

In the second multiple-point method the meter is held successively at 0.2 and 0.8 depth, and the mean of the velocities at these two points is taken as the mean velocity for that vertical. (See Pl. I, A.) On the assumption that the vertical velocity curve is a common parabola with horizontal axis, the mean of the velocities at 0.22 and 0.79 depth will give (closely) the mean velocity in the vertical. Actual observations under a wide range of conditions show that this multiple-point method gives the mean velocity very closely for open-water conditions and that in a complete measurement it seldom varies as much as 1 per cent from the value given by the vertical velocity curve method. Moreover, the indications are that it holds nearly as well for ice-covered rivers. It is very extensively used in the regular practice of the United States Geological Survey.

The single-point method consists in holding the meter either at the depth of the thread of mean velocity or at an arbitrary depth for which the coefficient for reducing to mean velocity has been determined or must be assumed.

Extensive experiments by means of vertical velocity curves show that the thread of mean velocity generally occurs between 0.5 and 0.7 total depth. In general practice the thread of mean velocity is considered to be at 0.6 depth, and at this point the meter is held in most of the measurements made by the single-point method. A large number of vertical curve measurements, taken on many streams and under varying conditions, show at the average coefficient for reducing the velocity obtained at 0.6 depth to mean velocity is practically unity. The variation of the coefficient from unity in individual cases is, however, greater than in the 0.2 and 0.8 method and the general results are not as satisfactory.

In the other principal single-point method the meter is held near the surface, usually 1 foot below, or low enough to be out of the effect of the wind or other disturbing influences. This is known as the subsurface method. The coefficient for reducing the velocity taken at the subsurface to the mean has been found to be in general from about 0.85 to 0.95, depending on the stage, velocity, and channel conditions. The higher the stage the larger the coefficient. This method is especially adapted for flood measurements, or when the velocity is so great that the meter can not be kept in the correct position for the other methods.

The vertical integration method consists in moving the meter at a slow, uniform speed from the surface to the bottom and back again to the surface and noting the number of revolutions and the time taken in the operation. This method has the advantage that the velocity at each point of the vertical is measured twice. It is useful as a check on the point methods. In using the Price meter great care should be taken that the vertical movement of the meter is not rapid enough to vitiate the accuracy of the resulting velocity.

The determination of the flow of an ice-covered stream is difficult, owing to diversity and instability of conditions during the winter period and also to lack of definite information in regard to the laws of flow of water under ice. The method now employed is to make frequent discharge measurements during the frozen periods by the 0.2 and 0.8 and the vertical velocity curve methods.

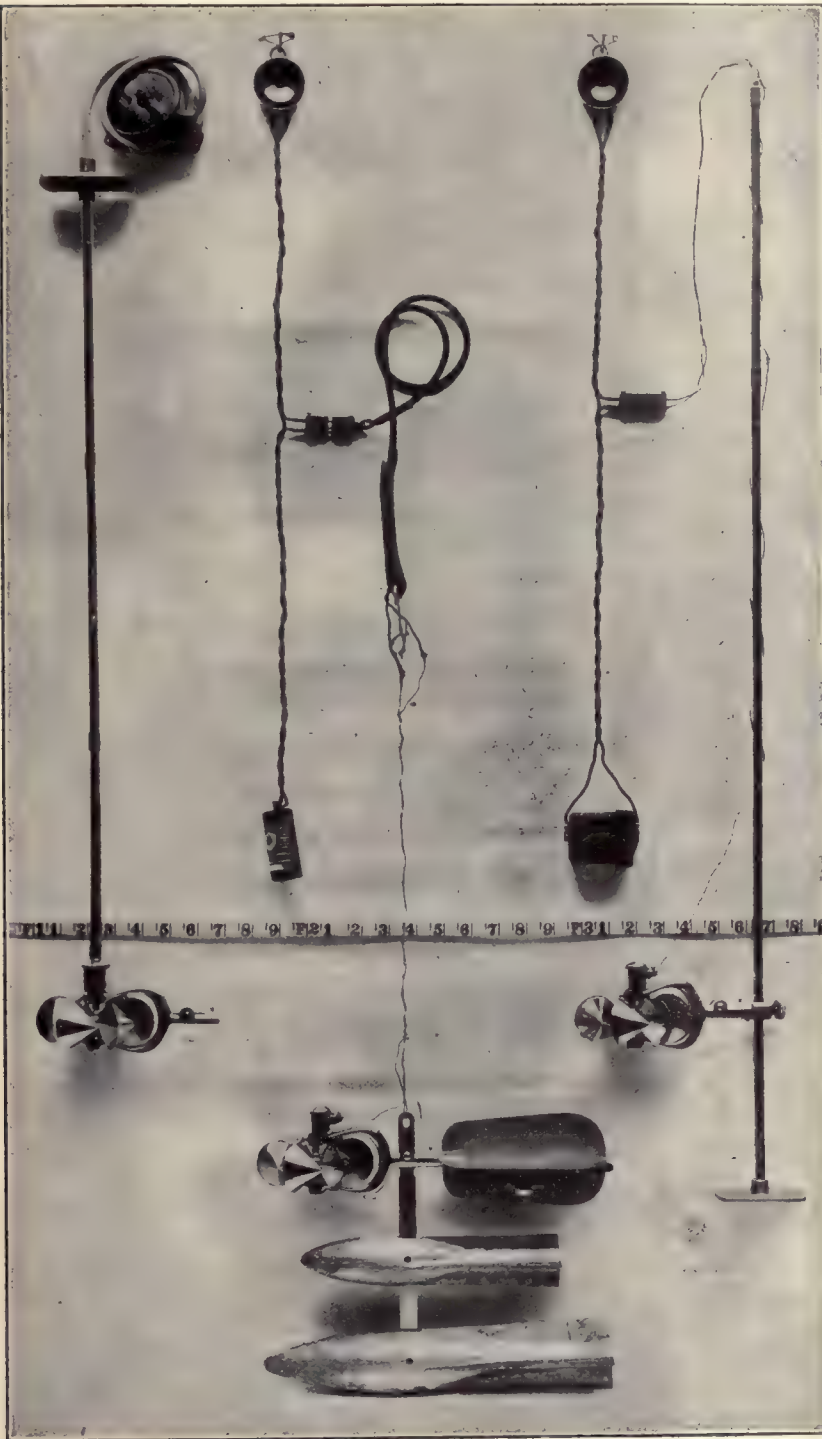


Plate II. The Price Current Meter.

changes in velocity from the surface to the bottom of the stream. The mean velocity in the vertical is then obtained by dividing the area bounded by this velocity curve and its axis by the depth. This method of obtaining the mean velocity in the vertical is probably the best known, but on account of the length of time required to make a complete measurement its use is largely limited to the deter-

Active Chicago Workers for the Nineteenth Irrigation Congress



1—Robert R. McCormick, Chairman, Board of Control, Nineteenth National Irrigation Congress.—(Photograph by Dana Hull, Chicago.)
 2—W. L. Park, Chairman, Committee on Attendance and Transportation, Board of Control, National Irrigation Congress.
 3—Dr. W. A. Evans, Chairman, Committee on Foreign Representation, Board of Control, National Irrigation Congress.
 4—Frank E. Scott, Chairman, Committee on Care of Delegates, National Irrigation Congress.

COAL AND OIL IN CALIFORNIA.

California's production of coal in 1910 was 11,164 short tons, with a spot value of \$18,336, according to E. W. Parker, of the United States Geological Survey.

In 1909 California showed the largest percentage of increase among the coal-producing states. In 1910 it showed the largest percentage of decrease. Both changes were due to fluctuations in the operations of the Stone Canyon Consolidated Coal Company, in Monterey county. For two years preceding 1909 this company had expended large amounts of money in developing its property and in building a 25-mile railroad to connect its mine with the Southern Pacific Railroad. Unfortunately unforeseen difficulties were encountered, and one misfortune followed another until the resources of the company were exhausted, and as it was unable to procure additional cap-

ital, a receiver was appointed and work was suspended in October, 1909. In the nine months from January to September of that year the Stone Canyon mines had produced 75 per cent of the state's output for the entire year. No coal was produced at this mine in 1910 and the production for the state decreased about 75 per cent.

All of the coal produced in 1910 came from Amador and Riverside counties, principally from the Ione mine in Amador county. This coal is lignite. The Stone Canyon coal is a non-coking bituminous coal of good quality and should make an excellent domestic fuel. It stands exposure well and with favorable freight rates would compete successfully with foreign coals in the markets of San Francisco and other cities of the state.

The small production of coal in California is offset

(Continued on page 24.)

Proposed Decimal System of Measures and Weights for the United States

By F. A. Smith C. E.

By the act of Congress approved as early as July, 1866, the use of the Metric System of Weights and Measures is permissible in the United States and contracts are declared valid, having the measures and weights given in that system. This shows that it was the intention of the Government of the United States at that time to gradually introduce that system into this country, superseding the cumbersome system now in use.

How little progress has been made in this direction can be seen when the fact is considered that no effort is made at all in our public schools to even give the grammar school graduates an outline of the Metric System and for all practical purposes the progress toward introducing this system into this country may be considered as nil.

The writer feels, therefore, justified in submitting the following basis for a new decimal system of measures and weights, specially adapted for the United States of America and being based upon the present mile as its underlying unit. The mile has been selected because our geographical lines and land surveys are now fixed quantities based upon this mile and the adoption of such a decimal system will not interfere with the present system of geographical subdivision above the square mile. Now let the

10th part of the mile be designated as decimile.

100th part of the mile be designated as centimile.

1,000th part of the mile be designated as millimile.

Then the divisions agree perfectly with those of our monetary system; namely, dollars, decidollars or dimes, centidollars or cents and millidollars or mills, and this should appeal favorably to the general public. The millimile then equals 5.28 feet of present measure, and by dividing this into 10 equal parts the writer suggests to call this unit so derived a *span*. There would then be 10,000 spans to the mile and it would equal in the present measure to .528' or 6.336 inches. The span then, if this system is adopted, would supersede our present foot. It would be subdivided into 10 equal parts, each called 1 decispans; the decispans would be subdivided into 10 equal parts, each called 1 centispans, and the centispans to be divided into 10 equal parts, each called 1 millispans. The millispans would equal .006336 inches and is a very small length but if desired it could be divided once more into 10 equal parts, each called 1 deci-millispans.

The above gives an outline of the linear units proposed. The square measure is derived by forming squares having the linear units for their sides.

In Figure 1 is shown the mile divided into 10 decimiles. If now a square be drawn over this line as indicated in Figure 2 the square mile appears divided into 100 equal squares, each called a square decimile and as the square mile contains 640 acres, then each of the 100 square decimiles is equal to 6.4 acres. So that 10 of them equal 64 acres, or about an ordinary farm. The writer will, in a future article, refer to these land divisions again.



Fig. 1.

For small square measures the *square span* forms the unit which equals .2728 sq. ft. or 40.1328 square inches; the subdivisions of the span giving all needed diversity in such measures, the square millispans being equal to .00004 square inches.

For solid liquid or dry measures the unit is the cubic span, which is a cube 1 span high, 1 span deep and 1 span long, being equal to 254.2814 cubic inches or 1.10078 gallons of present standards.

The small subdivisions would be formed by cubing the linear subdivisions, and the larger solid measures by cubing the subdivisions of the mile, as shown in the accompanying tables:

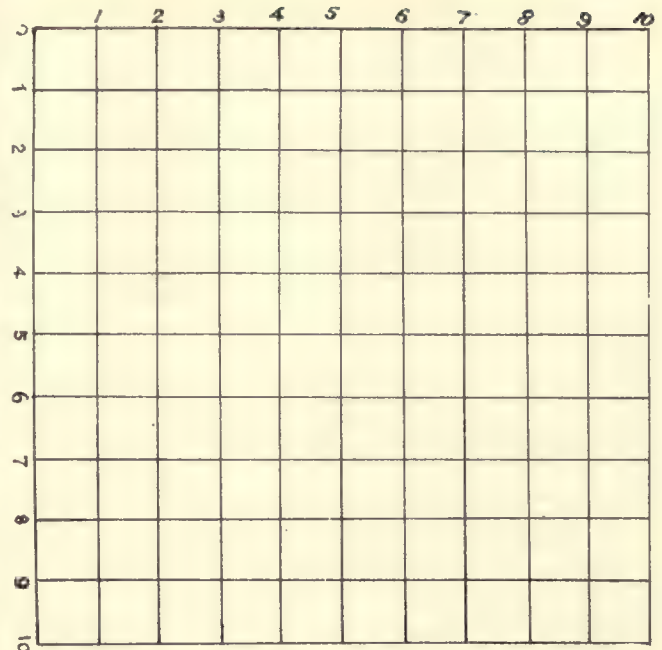


Fig. 2.

A. Linear Measure.

1 mile	= 10,000	spans = 5,280	ft.
1 deci mile	= 1,000	spans = 528	ft.
1 centi mile	= 100	spans = 52.8	ft.
1 milli mile	= 10	spans = 5.28	ft.
1 span	= 1	spans = .528	ft.
1 centi span	= 0.1	spans = .0528	ft.
1 centi span	= 0.01	spans = .00528	ft.
1 milli span	= 0.001	spans = .000528	ft.
1 decimilli span	= 0.0001	spans = .000053	ft.

B. Land and Square Measure.

1 square mile	= 100,000,000	sq. spans.
1 square deci mile	= 1,000,000	sq. spans.
1 square centi mile	= 10,000	sq. spans.
1 square milli mile	= 100	sq. spans.
1 square span	= 1	sq. spans.
1 square deci span	= 0.01	sq. spans.
1 square centi span	= 0.0001	sq. spans.
1 square milli span	= 0.000001	sq. spans.

C. Solid, Liquid and Dry Measure.

Small Divisions.

1 cubic span	= 254.2814	cu. in. = 1.10078 gal.
1 cu. deci. span = .001	cu. spans = .254	cu. in. = .0011 gal.
1 cu. centi. span = .000001	cu. spans = .000254	cu. in. = .000011 gal.

Large Divisions.

1 cubic milli mile	= 1,000 cubic spans
1 cubic centi mile	= 1,000,000 cubic spans
1 cubic deci mile	= 1,000,000,000 cubic spans = 1 billion
1 cubic mile	= 1,000,000,000,000 cubic spans = 1 trillion

Let the weight of a cubic span of pure water at its greatest density equal unity, then, as a cubic ft. of water weighs 62.5 lbs. and 1 cubic span equals 254.2814 cubic inches or .1417 cubic ft., the weight of this unit is obtained as 9.19375 lbs. of the old system, which is nearly 10 times the old pound. Call this weight of a cubic span of water one unit = 9.19375 lbs.

then 1 deci unit	= .1	unit = .919375	lbs.
1 centi unit	= .01	unit = .0919375	lbs.
1 milli unit	= .001	unit = .00919375	lbs.
1 deci milli unit	= .0001	unit = .000919	lbs.
1 centi milli unit	= .00001	unit = .000092	lbs.
1 milli milli unit	= .000001	unit = .000009	lbs.

For Weights Larger Than the Unit.

1 ten	units = 10	units = 91.9375	lbs.
1 hundred	units = 100	units = 919.375	lbs.
1 thousand	units = 1,000	units = 9,193.75	lbs.
1 ten thousand	units = 10,000	units = 91,937.5	lbs.
1 hundred thousand	units = 100,000	units = 919,375	lbs.

Of course, if desired, the prefixes ten hundred thousand

and ten thousand may be superseded by the Greek numerals, deka, hecto, kilo, myria, although the writer cannot see any advantages gained thereby. The system outlined above has all the advantages of the metric system so far as adaptability and saving of time is concerned and at the same time is simple in many of its parts and is particularly well adapted for use in the United States on account of the fundamental unit, the mile remaining undisturbed, and on account of its similarity to the monetary standard.

NEW GAME LAWS.

A comprehensive summary of the game laws of the United States and Canada, including those enacted during the present year, is set forth in Farmers' Bulletin 470, United States Department of Agriculture, soon to be issued by Secretary Wilson. The bulletin brings the data relating to game up to date and shows, by states, the new as well as old laws, changes, and modifications of all laws relating to shipment, sales, limits and licenses.

It is stated that while the 1911 laws exceeded in volume those of any previous year, that was due to changes in the warden service, control of license funds, and to the curtailment of the bag limit rather than to modifying of seasons. Notable modifications in the warden system were made in Delaware, New York, North Dakota, Oregon and Wyoming. Other states also passed laws increasing the warden force. Montana created three; North Dakota two game preserves, while Idaho and Washington added one each to their preserves. Massachusetts and Oregon made permanent arrangements for the creating of future preserves. California, Maine, Massachusetts, Michigan, Missouri, New Jersey and Wisconsin passed laws permitting the possession and disposal of game reared in private preserves. North Carolina joined the lists of states prohibiting the exportation of live quail for restocking purposes. New York adopted legislation closing its markets to all but a few foreign species and game raised in captivity.

A novel feature of new legislation was the prohibiting of the belling of dogs or use of other noise-producing devices in wild-fowl shooting in Delaware, and the prohibiting by North Dakota of the use of automobiles in duck hunting.

The deer season was shortened from eleven to six days in Colorado, and from 109 to 62 in California, but was lengthened in Michigan, South Carolina, Vermont and Wyoming. Cottontail and bush rabbits were placed on the game list and provided with a season in California. Wild ducks were added to the lists in Delaware and South Carolina; Delaware placed woodcock on the game list; Kansas, squirrels and snipe; Maine, eider ducks; Nebraska, kill-deers and doves; and New Jersey, Hungarian partridges. Much needed protection was given gray and black squirrels by Kansas; wild ducks by Massachusetts; wood ducks by Maine and Vermont; and doves and swans by North Dakota.

Rhode Island shortened its shore bird season, opening October 15 instead of July 15. Tennessee prohibited the sale of quail and robins. North Carolina revoked the authority of the Audubon Society to issue permits for the exportation of quail. Arkansas, Alabama, California, Colorado, Connecticut, Delaware, Florida, Idaho, Illinois, Indiana, Iowa, Kansas, Maine, Massachusetts, Michigan, Minnesota, Missouri, Montana, Nebraska, New Hampshire, New Jersey, New York, North Carolina, North Dakota, Ohio, Oklahoma, Oregon, Pennsylvania, Rhode Island, South Carolina, South Dakota, Tennessee, Texas, Utah, Vermont, Washington, West Virginia and Wisconsin all made changes in these laws. The total number of new game laws passed in 1911 was about 250.

THE EFFECT OF EROSION.

Some very interesting investigations by the United States Geological Survey of the erosions of numerous drainage basins of the nation reveal that the surface of the country is being removed at the average rate of about an inch in 760 years. Though this amount may seem trivial when spread over the surface of the entire country it becomes stupendous when considered as a total, or even in separate drainage basins.

The Mississippi river carries annually to the Gulf of

Mexico 136,400,000 tons of dissolved matter. Of this total the Ohio river carries 83,350,000 tons, while the Missouri river contributes more than twice that much. The Colorado river, which, like the Mississippi, has built for itself a vast delta, brings down more suspended matter than any other river in the United States, delivering annually 387 tons for each square mile of its drainage basin, or a total of 100,740,000 tons.

The rivers of the United States, the Geological Survey reports show, carry to tidewater each year 270,000,000 tons of dissolved matter and 513,000,000 tons of suspended matter. This total represents more than 350,000,000 cubic yards of rock, or 610,000,000 cubic yards of surface soil. If this erosive action could have been concentrated on the Isthmus of Panama, the report says, at the time of American occupation, it would have excavated the prism for an 85-foot level canal in about seventy-three days.

These figures were prepared by the Geological Survey for use by the National Irrigation Congress, which meets in Chicago Dec. 5 to 9 of this year, and which is interested in the drainage of the vast areas of the swamp lands created at the mouths of and along the nearby plains of many of the nation's waterways, the entire area thus created and possible of reclamation being 80,000,000 acres. The congress, at its sessions this year, hopes to bring about an extension of the work of the United States Reclamation Service by which reclamation work might be furthered in these lowland areas. This national development phase will be one of the most important topics before the December gathering.

CO-OPERATION BETWEEN EDUCATION AND AGRICULTURE.

Universities throughout the country have awakened to the present day need of a deeper application on the part of our college men to the study of agriculture in all its various branches. Not detracting from the advantages of the many professions that are encouraged in most educational institutions, suffice it to say that there are, each year, graduated from institutes of learning more lawyers, doctors, dentists, teachers and preachers than are required, while the country stands in absolute need of attention by minds and men scientifically trained in all of the varied branches of agriculture.

There is need of a course in agriculture that will be complete, and offer a term of study fitting the student to play an important part in the general development of the nation. With the advance of irrigation, dry farming methods, scientific plant breeding, intensive farming, seed selection, soil physics and fertility, the various branches of animal husbandry and modern methods of water and rainfall conservation, the need of scientific training is becoming more necessary. In this age of competition the combination of science with practical experience will help in a large measure to overcome the problems of crop uncertainty, which yearly occasions chaos and loss to the nation. Instead of this condition, a system of crop reliability ever increasing in usefulness and scope will be developed by the colleges where agriculture plays an important part in the educational work. Arizona has been quick to realize the advantages of scientific agriculture and prompt to establish a four-year course at its university at Tucson, which is perfect in completeness and which carries with it the degree of B. S. The university is entitled to the hearty commendation of the agricultural interests of the country at large for taking this step, the effect of which will be of national importance.

OUTDOOR STORAGE CELLARS.

Cheap and Useful in Both Summer and Winter.

On every farm in any locality there is need of a good outside cellar. In cold climates they afford the best and cheapest winter storage for fruit, vegetables, and bees. They are just as valuable in summer for keeping berries, milk, and butter. In the southwest such cellars offer the only means of safety during cyclones. Because they can do all the work themselves, farmers everywhere are building their cellars of concrete.

Building the Walls and Floor.

The most popular size for the average farm is a cellar

10 by 14 feet, inside measurements, with a self-supporting arched roof 5 feet above floor at the sides and 7 feet 8 inches in the center. All of the side walls are 8 inches thick, therefore dig the hole 11 feet 4 inches by 15 feet 4 inches and to the depth desired, usually 5 feet. At one end cut out the earth to a width of 4 feet 4 inches and slope it upward for seven concrete steps with a rise of 8 inches and a tread of 10 inches and for a thickness of 4 inches of concrete back of the steps proper. Arrange for an 18-inch landing at the bottom of the stair.

Make the side wall forms of 1-inch siding on 2 by 4-inch uprights spaced 2 feet. As the concrete floor will be 4 inches thick, set up the forms on 4-inch concrete

$\frac{3}{8}$ -inch rods. Roughen the top of the walls so as to insure a good bond with the roof. Build the stairway with a 4-inch thickness of concrete behind the steps proper. Each step has a tread of 10 inches and a rise of 8 inches. The sidewalks of the cellar hatchway extend above the door opening of the cellar proper, so that outside sloping doors may be added. In the top of the hatchway walls, while the concrete is soft, bolts are set heads down for holding the wooden sill to which the strap hinges are later attached.

The Self-Supporting Roof.

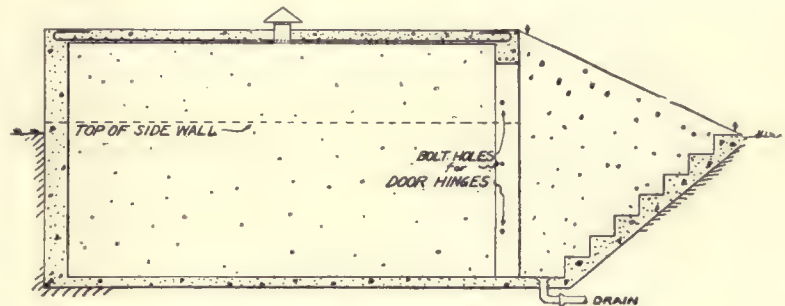
When the side walls are one week old, begin on the roof. To give the roof a rise of 2 feet 8 inches, arch rings are needed. For laying out the rings, choose a floor or a bit of level ground. To one end of a strong string fasten a pencil and tie the other end to a nail driven firmly in the floor with exactly 5 feet 11 inches of string between the pencil point and nail. Mark out half a circle. Across the circle lay a board exactly 10 feet long so that its ends just touch the mark. The part of the circle above the board represents the arched inside of the roof. Place boards for the arch rings over the mark on the floor and nail them together. Mark the curve upon them and cut them to the mark. Brace the arch well as shown in the drawing. Spacing the rings 2 feet apart, six will be needed. Fasten them securely in place to 2 by 6-inch liners spiked to the side wall forms. Cover the rings tightly with 1-inch sheathing.

With the roof form ready, place the reinforcement upon it. Use $\frac{3}{8}$ -rods 14 feet long. Space them 6 inches apart crosswise and 12 inches the long way of the cellar. Wire the rods together where they cross. The roof must be 5 inches thick. Carefully work exactly 1 inch of concrete between the rods and the sheathing. Tamp the concrete until the liquid cement flushes



View of Storage Cellar.

bricks. Above ground level use outside forms similar to the inside. To curve the end wall forms, lay them out with a 6-foot string in the same way as described below for arch rings. At the entrance end, to provide for a doorway, set between the forms a frame of 2 by 8-inch stuff 3 by 7 feet in the clear. Mix the concrete 1 part Portland cement to 4 parts bank-run gravel, or 1 part cement to 2 parts sand to 4 parts crushed rock. A sack of cement equals 1 cubic foot. With the forms in place, lay the 4-inch floor the same as a sidewalk, but without joints. Fill the wall forms in 8-inch layers with mushy wet concrete and 6 inches from the top of the side walls and 1 inch from the outside place two $\frac{3}{8}$ -inch steel rods the full length of the cellar. In the concrete two inches above the door-frame lay three four-foot lengths of

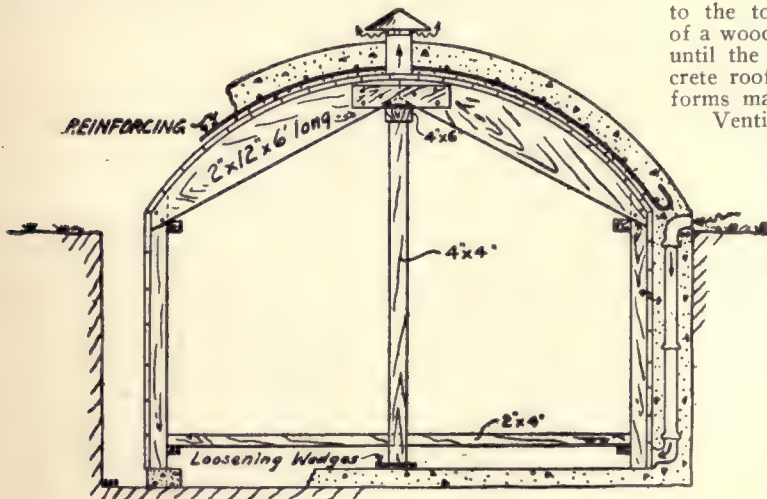


Longitudinal Section Through Cellar.

to the top and then finish the surface smooth by means of a wooden float and steel trowel. Do not stop for anything until the roof is finished. In two to three weeks the concrete roof will be strong enough to support itself; then the forms may be removed.

Ventilation is necessary for most cellars. While building the wall make one or more air-shafts (similar to a chimney flue) of 3-inch tile, by imbedding them in the concrete wall with, an opening inside at floor level and another outside well above ground line. By this arrangement fresh air is admitted. Place a tile chimney in the concrete roof and cover it with a galvanized iron hood for removing the foul air. If built late in the fall, protect the fresh concrete from freezing by covering it with clean straw or with old carpet so suspended as to leave a dead air-space between the concrete and the covering.

The cellar shown in the photograph is 18 by 18 feet by 8 feet deep. It is located on an apple farm. The owner finds it a profitable investment as he has his own storage and keeps his apples until the prices are right.



Transverse Section Through Cellar.

THE PRIMER OF HYDRAULICS*

By FREDERICK A. SMITH, C. E.

Article XIII. Problems. Open Channels.

A. Triangular Channel.

1. Find Velocity When the Other Quantities Are Given. In Fig. 81 is shown a problem where a reservoir of water

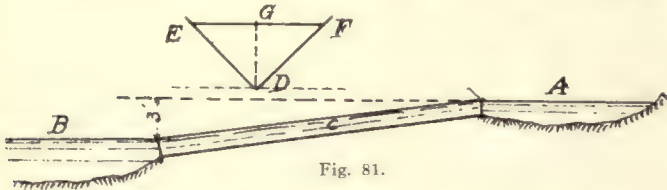


Fig. 81.

A is connected by a timber flume C, made of very smooth planed boards, to a reservoir B whose level is lower than A a distance of 3 feet. The length of flume is 6,600 ft., and cross section of flow is uniform throughout entire length; the surface levels in A and B are supposed to be constant.

Find quantity of water discharging per second if the depth of flow GD equals 30 inches and angle EDF = 90°, the triangle EDF being the cross section of the flow.

Solution. Assume coefficient of roughness .011. Find the slope s by dividing 6,600 into 3, which gives .00045. To find r first find area of triangle EFD, which equals $GD \times EG = 2.5 \times 2.5 = 6.25$ sq. ft. The wetted perimeter equals $ED + DF$; $ED = \sqrt{12.50} = 3.535$; hence $r = 6.25 \div 7.07$.

$$r = .8803.$$

$$\text{Take } \sqrt{r} = \sqrt{.8803} = .938.$$

Consult "C" table under, $n = .011$ (Table III); in column $s = .0004$ we find $C = \text{for } .9 = 133.79$.

$$\text{for } 1.0 = 138.92.$$

Hence, for a one-tenth part of \sqrt{r} C advances 5.13, or .0513 for 1/1,000 part of \sqrt{r} ; so for .038 parts the advance is 38 times .0513 = 1.95; add this to 133.79 gives 135.74; this is the exact factor C for this case.

The mean velocity v is now determined from the formula: $v = C \sqrt{rs}$.

Substitute above values:

$$v = 135.74 \times .938 \times .021.$$

$$v = 2.67 \text{ ft. per second.}$$

Hence quantity Q in cub. ft. per second.

$$Q = 6.25 \times 2.67 = 16.687 \text{ cub. ft.}$$

2. Find Size of Flume if the Other Quantities Are Given.

A variation of the problem may be worked by assuming the slope as before, but require the size of flow for a required capacity.

Problem: Find depth GD to deliver a flow of 50 cub. ft. per second.

As stated before, $n = .011$ and $s = .00045$. Let $GD = x$; then $x^2 = \text{area of cross section of flow}$ and $50 \div x^2 = v$.

$$\text{Also } r = x \div 2 \sqrt{2}.$$

Substitute these values in $v = C \sqrt{rs}$; we get:

$$50 \div x^2 = C \sqrt{xs} \div 2 \sqrt{2}$$

Square both sides:

$$2,500 \quad C^2 xs$$

$$=$$

$$x^4 \quad 2,828$$

$$C^2 xs = 2,828 \times 2,500.$$

Assume C as above at 135 and $s = .00045$, we get:

$$x = \sqrt[5]{2,828 \times 2,500 \div 135 \times 135 \times .00045}.$$

$$x = \sqrt[5]{7,070 \div 8.2} = \sqrt[5]{862.2}.$$

The 5th root is best extracted by means of logarithms:

$$\text{Log. } 862.2 = 2.93561.$$

$$\text{Divide by } 5 = 0.58712.$$

Look up number corresponding to this logarithm:

$$x = 3.865.$$

Hence the depth of flow is 3.865, which will give the flume a capacity of 50 cub. ft. per second.

To check this back assume depth as 3.865 and ascertain flow: area = $3.865 \times 3.865 = 14.938$.

$$r = 3.865 \div 2.828 = 1.367.$$

$$v = 135 \sqrt{1.367 \times .00045}.$$

$$v = 135 \times .0248.$$

$$v = 3.348 \text{ ft.}$$

Multiply by area 14.938.

$Q = 50.6$ cubic ft; thus it is seen that the problem checks back correctly.

B. The Rectangular Channel.

3. Problem.

A flume of rectangular cross section (see Fig. 82) 24x24" is tapping a river at its upper end and is 3 miles long, having a uniform grade of 5 ft. per mile. Find velocity and quantity of water if factor $n = .012$ and if depth of flow = 16".

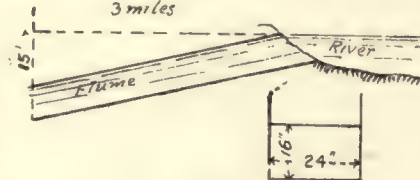


Fig. 82.

Solution. In this case n , r and s are given and the problem can be worked accordingly.

$$\text{Area of flow} = 2 \times 1\frac{1}{3} = 2\frac{2}{3} = 2.67 \text{ sq. ft.}$$

$$\text{Wetted perimeter} = 2 + 1\frac{1}{3} + 1\frac{1}{3} = 4\frac{2}{3} = 4.67 \text{ ft.}$$

$$\text{Hydraulic radius} = 2.67 \div 4.67 = .5717.$$

$$\sqrt{.5717} = .756.$$

$$s = 5 \div 5,280 = .00095.$$

Consult table No. IV ($n = .012$) and factor C will be found under slope .001 (which is nearest to .00095) and opposite \sqrt{r} column, between .5 and .6, or the proportional part for .5717; it will be near enough to compute C for .57;

$$C \text{ for } .50 = 94.52.$$

$$C \text{ for } .60 = 103.44.$$

$$\text{Difference: } 9.12$$

This is a variation of .91 for .01 increase in \sqrt{r} ; thus for .07 it is 7 times .91 = 6.37; add this to 94.52 gives 100.89, as C for $\sqrt{r} = .57$.

In the fundamental formula:

$$v = C \sqrt{rs}. \text{ Substitute values:}$$

$$v = 100.89 \times .57 \times \sqrt{.00095}.$$

Consult table XIV of square roots; under x find $\sqrt{.0009} = .03$.

$$\text{Under } \sqrt{.0010} \text{ you find } .03162.$$

$$\text{Difference: } .00162.$$

Hence $\sqrt{.00095}$ equals .03 plus half of .00162, or $\sqrt{.00095} = .03081$.

$$v = 100.89 \times .57 \times .03081.$$

$$v = 1.7678 \text{ ft. per second.}$$

The quantity of water per second equals cross section times mean velocity:

$$Q = 2.67 \times 1.77 = 4.726 \text{ cub. ft. per sec.}$$

C. Trapezoidal Channel.

4. Problem.

A mill race of trapezoidal cross section has a bottom width of 3' 4" and the depth of flow is 2 ft.; the slope is 6 inches in 1,000 ft.; the side walls of the channel have an inclination of 60° to the horizon, and bottom and walls are constructed of concrete plastered fairly smooth. Find mean velocity of flow.

Solution. Let Fig. 83 represent the cross section of channel, and AE be depth of flow = 2 ft.; then $AC = BD = 2 \div \sin 60^\circ$, and $CE = FD = 2 \div \cos 60^\circ$; this makes $AC = 2.309$ ft. and $CE = 1.1545$ ft. The area of flow and length of wetted perimeter can now be readily determined: Area of flow: $(AB + CD) \div 2 \times AE = (3.33 + 1.13 + 3.33 + 1.13) \div 2 \times 2 = 8.91$ sq. ft.; the wetted perimeter = $CA + AB + BD = 2.309 + 3.333 + 2.309 = 7.951$ ft.

$$\text{Hence hydraulic radius} = 8.91 \div 7.951 = 1.1205.$$

$$\text{And } \sqrt{1.1205} = 1.059.$$

If we now assume the coefficient $n = .013$ we have all the necessary elements to make use of the tables $s = 5 \div 1,000 = .0005$; table No. V ($n = .013$), under slope .0004 (which is nearest to our case), we find C opposite \sqrt{r} ; for

$$\sqrt{r} = 1.0 \quad C = 115.29; \text{ for}$$

$$\sqrt{r} = 1.2 \quad C = 123.06; \text{ difference for } .2 = 7.77, \text{ then}$$

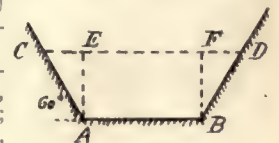


Fig. 83.

difference for .001 = .0388, and for .044 it will be $44 \times .0388 = 1.7072 = 1.71$; add this to 115.29 gives 117.00 for factor C in this case.

Substitute the known quantities in formula: $v = C \sqrt{rs}$
 $v = 117.0 \times 1.059 \times .022 = 2.726$ ft.

The quantity of flow per second = $av = 8.66 \times 2.726 = 23.607$ cub. ft. per second.

Supreme Court Decisions

Irrigation Cases

DRAINING SURFACE WATER—

A court of equity will not enjoin an upper proprietor from draining surface water from his land through tile drains in the natural course of drainage into the natural channels which nature has provided and onto the land of a lower proprietor.—*Perry v. Clark*, Supreme Court of Nebraska, 132 Northwestern 388.

DRAINAGE OF SURFACE WATER—

While the natural flow of surface water onto one's land may not be complained of, he may complain of its discharge thereon, by interference with natural conditions, in greater quantity or in a different manner than would occur under natural conditions.—*Heier v. Krull*, Supreme Court of California, 117 Pacific 530.

RIGHT TO NATURAL FLOW—

An irrigation company cannot obstruct the natural flow and overflow of the outlet of a lake, to the injury of a lower riparian owner, riparian owners having the right to the natural flow of waters in their natural and accustomed channels without diminution or alteration.—*Still v. Palouse Irrigation & Power Co.*, Supreme Court of Washington, 117 Pacific 466.

PROVING APPROPRIATION—

Proof that haying was done on the respective meadows of parties claiming prior appropriation of water for irrigation, without evidence as to whether the hay was raised by artificial irrigation or by the use of a natural overflow, was insufficient to establish an appropriation.—*Anderson Land & Stock Co. v. McConnell*, Circuit Court of Nevada, 188 Federal 818.

DRAINS—

The mere fact that a drainage district was formed to drain lands in the vicinity of plaintiff's lands, and for that purpose purchased a right of way over his lands, and constructed a ditch thereon, does not show it has right to divert thereto additional waters from the other side of watershed, making it overflow its banks and injure his lands.—*Heier v. Krull*, Supreme Court of California, 117 Pacific 530.

OBSTRUCTION OF DRAIN—

A lower proprietor may not unnecessarily obstruct a natural drain upon his own premises without the upper proprietor's consent, so as to collect surface water and cast it back upon his neighbor's farm, where it would not appear but for that obstruction, and to the injury of his neighbor's crops and land.—*Mapes v. Bolton*, Supreme Court of Nebraska, 132 Northwestern 386.

IRRIGATION COMPANY'S RIGHT ON DITCH—

Where an irrigation company acquired the right to maintain a ditch through certain land, its right extended to the bed of the ditch and to sufficient ground on either side to properly operate the same, but did not confer authority to place a greater servitude or burden on the lands than existed at the time the ditch was constructed, or was reasonably necessary to properly operate it.—*Arthur Irr. Co. v. Strayer*, Supreme Court of Colorado, 115 Pacific 724.

CONVEYANCE OF WATER RIGHTS—

Where the intention of the owners of the stock in an irrigation company was to retain certain water rights, and at the same time to convey to other parties their canal and prior appropriation of water, and this was done by means of the transfer of stock and issuance of water right contracts, a court of equity will treat the transaction as it actually was, and not as it appeared to be, in order to protect the rights of the original stockholders.—*Fenton v. Tri-State Land Co.*, Supreme Court of Nebraska, 131 Northwestern 1038.

CHANGE OF EASEMENT—

Where one has a right merely to divert, at a certain

point on defendant's land, water from a stream, and conduct it by a certain route and means over such land, the fact that they will not be injured by his diverting it at a different point on their land and conducting it over such land by a different route and different means does not entitle him to make the change, though the elements have rendered it impossible to divert it at the original point and conduct it by the original way and means.—*White Bros. & Crum Co.*, Supreme Court of Washington, 117 Pacific 496.

ABANDONMENT OF WATER RIGHTS—

Since grantees of land with appurtenant water rights could not demand that water be furnished from a particular one of several sources of supply from which they were entitled to water, so long as they were conveniently furnished the amount to which they were entitled, their failure to demand a supply from a source included in their deed would not be a waiver of their right to such supply, when the source from which water was formerly furnished them became inadequate.—*Smith v. Cucamonga Water Co.*, Supreme Court of California, 117 Pacific 764.

PRIORITY OF APPLICATION—

Where, in 1891, certain owners of an irrigation canal which was in operation for a distance of about ten miles, conveyed the same, reserving to themselves a perpetual right to water under a common agreement, the court will apply the provisions of chapter 68, Laws 1889, and hold their rights equal as to each other, but superior to those of consumers under a new section of canal beginning at the end of the ten miles already in operation.—*Fenton v. Tri-State Land Co.*, Supreme Court of Nebraska, 131 Northwestern 1038.

DIVERSION—

Though plaintiff appropriated the water of a stream and diverted it at a point on land owned by the United States, so that under Rev. St. U. S. § 2340 (U. S. Compiled St. 1901, p. 1437), defendants took title to the land subject to his vested and accrued water rights and his rights to ditches and reservoirs used in connection with such water rights, he merely took an easement, which he could not thereafter change without defendants' consent, as to the point of diversion of the water or the place or means of conveying it over defendants' lands.—*White Bros. & Crum Co.*, Supreme Court of Washington, 117 Pacific 497.

APPROPRIATION—

Where complainant's predecessor in title, though conceding a prior appropriation by defendants, was entitled to the unused water naturally flowing to him from defendants' land, and was entitled to insist that such unused water be not diverted elsewhere, but should be allowed to return to the stream and serve his appropriation, such unused water was not waste water, but excess above the water defendants were entitled to appropriate, which could not by subsequent enlargement of their ditches, etc., appropriate to complainant's prejudice.—*Anderson Land & Stock Co. v. McConnell*, Circuit Court of Nevada, 188 Federal 818.

DAM AND RESERVOIR SITE ON SCHOOL LANDS—

Notwithstanding Const. art. 7, §§ 2, 4, 5, providing that all alternate sections of land shall constitute a school fund, that school lands shall be sold under legislative regulations, that the Legislature may not grant any relief to purchasers of school lands, and that the school funds shall be the permanent school fund, the interest of which shall be applied annually to the support of the public free schools, the Legislature, to facilitate the sale of school lands and to enhance their value, may grant an easement on the lands for dam and reservoir sites for water for irrigation; such power being inherent in the sovereign government and growing out of necessity.—*Imperial Irr. Co. v. Jayne*, Supreme Court of Texas, 138 Southwestern 575.

PRIOR APPROPRIATION—

Act March 3, 1887, c. 108, 19 Stat. 377, referring to desert lands, provides that all surplus water over and above such actual appropriation and use, together with the water in all lakes, rivers, and other sources of water supply on public lands, shall be free for appropriation, irrigation, mining and manufacturing purposes. An irrigation company which had built a dam across the outlet of a lake, thus cutting off the stream fed by the lake, claimed that a lower riparian owner could not object to its appropriation of the water, because the common-law doctrine of riparian ownership was abrogated. Held, that the statute applied only to desert lands and required a bona fide appropriation, and, as the irrigation company had not within five years after its original appropriation completed its work, it had not under Rem. & Bal. Code, § 6318, used sufficient diligence to con-

firm it, and hence the lower riparian owner might object; it also appearing that his lands had not been settled or acquired as desert lands—*Still v. Palouse Irrigation & Power Co.*, Supreme Court of Washington, 117 Pacific 466.

RIGHT TO SUPPLY OF WATER—

Equal areas of land were devised by the same will to plaintiff and defendant, with the request that they use jointly the water and irrigating ditch, as they were desired to be joint owners of the ditch and of the water rights, and the decree of distribution followed the will. The irrigation ditch entered and was wholly upon defendant's land, and plaintiff extended the ditch from its terminus over defendant's land to the boundary of his own land, which without irrigation was worthless; that being the only way he could use the water rights devised to him. *Held*, in an action to be let into undisturbed possession of a part of the water rights and of the extended ditch, and to establish a perpetual easement on defendant's land for the benefit of plaintiff's land, that in view of Civ. Code, § 3522, declaring that one who grants a thing is presumed to grant whatever is essential to its use, if that be within the power of the grantor, plaintiff was entitled to extend the ditch, and to have an undisturbed use of it for the benefit of his land.—*Sulloway v. Sulloway*, Supreme Court of California, 117 Pacific 522.

EASEMENT IN WATERCOURSE—

Owners of a tract of land partitioned it in 1872, one taking land on which certain springs were located and granting to the others and their assigns the right to use the water of the springs in common and the right to lay pipes thereto. Under warranty deeds the title to the land on which the springs were located vested in the state in 1886, and it took possession under its deeds, and thereafter claimed and enjoyed the exclusive rights to the springs. The other original owners of the tract never took any possession of these springs, and by warranty deeds, containing no reference to the springs, plaintiff acquired title in 1902, and in 1904 conveyed a part of the land to the state, and subsequently, in 1906, obtained from her grantors a quitclaim deed of their rights in the springs. *Held*, in an action to establish a right to the use of the springs in common with the state, that the state's possession of the land and of the springs situated thereon, with claim of exclusive right and title, operated to disseise or oust the other owners or cotenants and to convert possession into an adverse possession which had determined the estate of plaintiff's grantors, the other owners or cotenants.—*Church v. State*, Supreme Court of Washington, 117 Pacific 711.

IMPORTANT INFORMATION RELATIVE TO THE IRRIGATION CONGRESS.

To the landless and homeless the National Irrigation Congress will bring glad tidings of opportunity for lands and homes on the millions of acres reclaimed under the spirit awakened by western irrigation and swamp land drainage. So states the official call for the nineteenth session at Chicago, December 5 to 9 next, which has been issued over the signatures of B. A. Fowler, Phoenix, Ariz., president; Arthur Hooker, Chicago, Ill., secretary; R. Insinger, Spokane, Wash., chairman of the executive committee, and Robert R. McCormick, Chicago, Ill., chairman of the board of control.

It is fitting that this great agricultural and industrial development agency should at this time hold a great meeting in Chicago, one of the world's most important industrial and commercial centers. The lands available for private settlement, long thought unlimited, are practically exhausted, so that continued extension of settlement must depend on the reclamation of land by control of the water supply; and Chicago is the clearing house for the western country involved in the new era of land development.

The peculiar fitness of Chicago for this meeting inspired the invitation and actuates a strong board of control who have undertaken to make the nineteenth meeting of the National Irrigation Congress the most successful in its history.

Here where East and West meet the congress will point with pride to that empire-building which made the "Great American Desert" a country of happy homes and of bounteous productivity.

Never more important than now, when the population of the country is so rapidly increasing, were the objects of the congress expressed in its motto, "Save the forests,"

(Continued to page 28.)

CORRESPONDENCE

AN ANSWER TO MR. KINDER.

THE IRRIGATION AGE,
Chicago,

Gentlemen: I have read with interest the inquiry of Wm. R. Kinder, C. E., page, 1108 of your October issue, and I have a suggestion to make which has been effective in similar places and under similar conditions. I would install a small current water wheel in the ditch, just above the syphon. Attach to this an endless belt slot carrier with hooks just above the wheel. This device is positive in its action, inexpensive, obstructs the flow of water very little and needs attention only occasionally, to burn the trash carried out.

A. F. AMES, Heyburn, Idaho.
A Practical Irrigator.

RECLAIMING UNDERGROUND WATERS.

Pueblo, Colo., October 16, 1911.

Mr. D. H. Anderson,

Publisher THE IRRIGATION AGE:

Dear Sir: The article in your September issue by Mr. Smith, describing his plan of obtaining the underflow by a sub-surface dam on the Cienega Ranch, Ariz., at a cost of \$7,350, interested me because I thought there was a much better way of obtaining several times the result in the quantity of water obtained and at a much less first cost, with less danger of damage from flood.

Knowing there are many thousands of acres along the water courses of the vast arid regions that can be irrigated by the underground water of these streams, for the benefit of those contemplating this work, and as a hint to others who may not realize the value of this asset within their reach, I submit herewith a sketch of my plan of collecting these waters, designed some years ago.

The sketch will need but little explanation to one at all acquainted with hydraulics. The pipe should be laid 4 to 8 feet deep to place it below danger of floods. The perforated wells or casings may extend to above the surface and capped instead of the concrete crown, as shown. These casings are sunk by dredging out from within, preferably by an orange peel dipper attached to a beam.

A ground plan would show that the pipe line might be laid on one side of the present active stream flow and the wells in the stream bed and the suction branch pipes extended from the main to them.

A 12-inch main at a grade of 40 feet will carry 3.8 cubic feet of water per second; a 6-inch branch 1.35 cubic foot. All joints should be tight.

If laid below the water plane the whole pipe system will fill up with water, and when the outlet valve is opened the flow of the water outward will create a vacuum and the syphons will draw the water from the sand bed down to about the level, as shown. Where there is no surface flow the amount of water in the average stream sand bed can be computed by finding the cubic feet of sand that will be drained by the system. From each 5 to 7 cubic feet of average sand bed, free from silt, will be obtained 1 cubic foot of water, while taking this water out, if the system has capacity enough. More water will be obtained than the regular amount of water passing through the sand bed of the stream at any one point. That is, it will be found that in the average stream bed 20 feet deep by one-half mile wide the amount of underground water passing through the sand will not exceed 5 to 10 second feet, which would be the capacity of the system were there no periods of surface flow or flood. By the system I have here shown, the drained sand bed represents a permanent reservoir into which the surface water percolates as through a sieve, and if the flow is large enough to fill the sand reservoir and pass over the drained area the deposited silt will be again scoured off and the top left clean for the receiving of the next flow freely. Hence a reservoir of which the dam will never break nor ever fill up with silt and sediment.

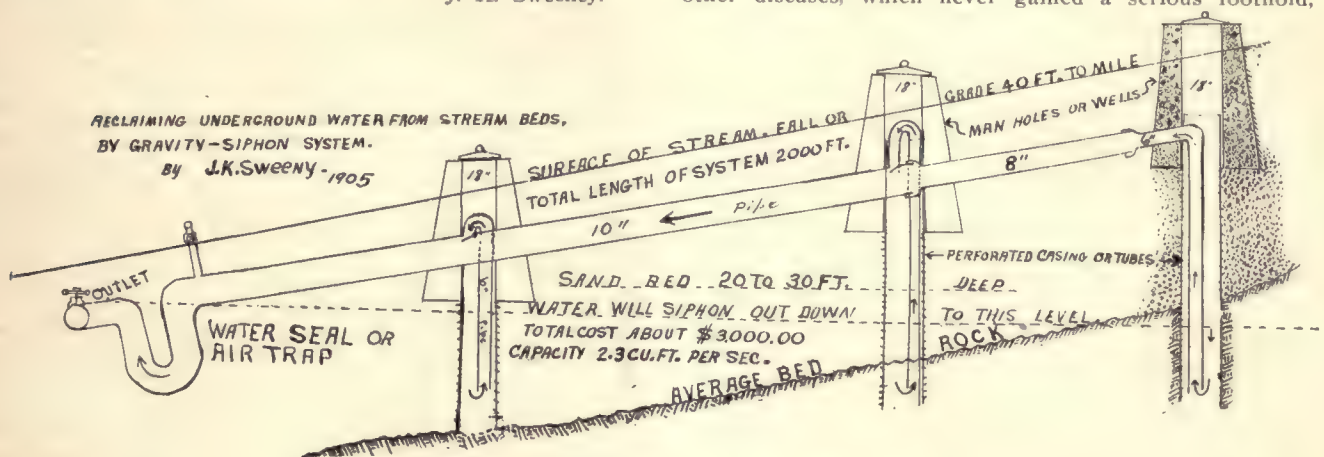
As against the sub-surface dam of Mr. Smith's, and many others I know of that have proved almost entire failures,

by washing away, because the builders did not realize that in case of an ordinary flood, say 5 or 10 feet high, that the whole sand bed for even 15 feet deep is moving bodily down stream, and should the dam be made strong enough to hold this force, the sand reservoir being always full of water, there is no reserve and the deposited silt being held back, the porosity of the affected area becomes less each year.

The gravity siphon system has some advantages over the underdrain collecting galleries plan, that is frequently used, in addition to the large amount saved in first cost, for a small system, the main advantage is that very often there are other water bearing strata below the first sand bed by sinking the perforated tubes through the intervening clay or rock layers the water frequently rises to the height of the upper water plane and is siphoned out with the top flow. The draining of the upper bed does not usually affect the lower flow, or its pressure.

The perforated tube or well and the suction pipe within should all extend down below the suction limit or below the siphon outlet to prevent air from getting into the suction pipes. It may be necessary at times to use a suction pump to relieve accumulated air in the crown of the siphon.

J. K. Sweeney.



Reclaiming Underground Water from Stream Beds.

OF INTEREST TO IRRIGATORS.

THE IRRIGATION AGE,
30 North Dearborn Street,
Chicago, Ill.

Gentlemen:—We enclose our check for \$1.00, for one year's subscription to THE IRRIGATION AGE, beginning with November, 1911, issue.

We have recently opened offices at 52 Broadway, New York, and intend making a specialty of irrigation work, having on our staff engineers thoroughly experienced in irrigation engineering and construction. We are prepared to assist in financing any meritorious irrigation project upon which we make a favorable report, and also to supervise the construction work and management of the enterprise.

We would greatly appreciate any suggestions you may care to offer as to the best method of getting in touch with people requiring services of this character.

Yours very truly,
B. C. DONHAM & COMPANY,
By J. L. Stewart.

FROM THE PACIFIC NORTHWEST.

Editor IRRIGATION AGE.

Robert J. Maclean, secretary of the Spokane Chamber of Commerce, has forwarded a lengthy communication to James Wilson, secretary of the United States Department of Agriculture, urging him to ascertain the source of the reports, sent broadcast from Washington, D. C., that deterioration is noted in western orchards where intensive methods are practiced, also to instruct the Bureau of Pomology and the Reclamation Service to issue official statements setting forth the fact that the reports are without foundation and were not authorized by the department.

Mr. Maclean says he has been authorized by prom-

inent growers in Washington, Oregon, Idaho, Montana and other western states to invite the most rigid investigation of the irrigated districts, to show there is no truth in the rumors that irrigated orchards are going back or declining in productivity and value, adding:

"It appears very much as if a deep plot were laid to injure the reputation of the Pacific Northwest, which now is justly famed as the world's commercial apple district, and also harm other western states. California, Oregon, Washington and western states generally are mentioned in the Washington press report, saying the Department of Agriculture has decided to begin an investigation to determine the cause of the deterioration of orange, apple and pear orchards. The whole thing is a base fabrication from beginning to end.

"The Spokane Chamber of Commerce, which has the support of commercial organizations and growers all over the western country, is determined that this grievous wrong to the west be righted without delay. Western orchards are thriving and increasing in value yearly and the growers are prosperous and contented; tree pests and other diseases, which never gained a serious foothold,

have been reduced to a minimum, and in justice we demand that the truth be told."

AUGUST WOLF,
225 Hutton Building, Spokane, Wash.

WANTS INFORMATION ON THE CURTISS ACT.

Publishers THE IRRIGATION AGE, Chicago, Ill.

Being a subscriber to your paper, will thank you for the following information desired, by mail:

Is there a law known as the "Curtiss Act" which forbids a construction company under the Carey Act from collecting payments on water rights until said company furnishes water to raise one crop? Is it a state or national law and if effective in Colorado? Where can I obtain copy of same? Thanking you in advance, I remain,

Yours truly,
Box 56, Two Buttes, Colo.

(Can some of our readers supply the desired information to Mr. Rennecker? An answer either directly to Mr. L. H. Rennecker, Two Buttes, Colo., or a letter to the Editor IRRIGATION AGE will be appreciated.—EDITOR.)

PERSONAL.

Mr. Gano Dunn has just returned from abroad, where, as a representative of the United States Government, and as president of the American Institute of Electrical Engineers, he has been attending the International Electrical Congress at Turin and the meeting of the International Electro-Technical Commission, the body that has been organized to bring about the international uniformity of standards and practice in the electrical industry.

Mr. Dunn, who for many years was first vice-president and chief engineer of the Crocker-Wheeler Company, and is a past president of the New York Electrical Society, has been elected a director and a vice-president of J. G. White & Company, Inc.

Reclamation Notes

CALIFORNIA.

The most important irrigation project in Santa Barbara county, aside from that of the Union Sugar Company in the Santa Maria Valley, is now in a fair way of fulfillment in the Sisquoc region.

At Howell Point, a forty-inch pump has been installed for the reclamation district. The capacity of the pump is 60,000 gallons a minute. The district has another pump which throws 30,000 gallons a minute. The two pumps working together will lower the water on 240 acres one inch per hour.

A tract of land embracing 284 acres in the Perris Valley, known as the Bernasconi Hot Springs, has been sold by Iowa parties to the Equitable Realty Company of Los Angeles for a reported consideration of \$30,000. This tract is located eighteen miles southeast of Riverside. Forty acres of the land is to be laid out in half-acre building lots and the remainder will be subdivided into orange land. This tract will be supplied with an abundance of water for irrigation.

The directors of the South San Joaquin and Oakdale Irrigation districts have awarded the contract for the construction of a joint canal to J. A. Green & Co. of Chicago for \$700,000. The Chicago firm will finance the bonds, subject to the impending decision of the Supreme Court on the legality of the formation of the districts. The contract calls for tunneling, rock drilling and cement work. The completion of the contract will bring water down to the dividing line. Work will be started immediately.

It is reported that capitalists are interested in the reclamation of Boulding Island, situated near Stockton, which has been inundated for eight years and that the tract of 6,156 acres may again be the factor in the production of the delta area. T. P. Andrews of San Francisco is reported to be at the head of the Reclamation Company who will undertake this work.

Bonds to the extent of \$25,000 for the installation of an irrigation plant which will derive its supply from wells which will tap the underflow from the Tijuana River will soon be issued by the San Ysidro Irrigation district. The plant, as proposed, will furnish a continuous flow of nine gallons of water per minute. The cost of the plant and the operating expenses will be assessed pro rata among the property owners using the water.

A temporary injunction has been served on the Lake County Board of Supervisors by the Yolo County Consolidated Water Company to prevent that body from enlarging the outlet of Clear Lake. The Lake county supervisors want the outlet enlarged to lower the surface of the lake, but the water company want to prevent this, inasmuch as it would decrease the supply of water for irrigation purposes late in the summer. The water company has also asked for \$5,000 for damage alleged to have been already done.

F. M. Turner of Browns Valley has secured 25,000 acres of land in northern Yuba county and has interested eastern capitalists in the reclamation of same. The water for irrigation purposes will be taken from Dry Creek. The land to be irrigated is claimed to be some of the best apple land in the world.

Articles of incorporation of the Las Velejas Land Company, which owns a large tract of land near Bangor, were filed in Oroville early this month. The principal place of business is San Francisco and the capital stock is estimated at \$250,000. The company will build a large

irrigation canal and will subdivide the land into small tracts. Among those interested in the project are A. M. Cavan of Oakland, Milton Newmark of Berkeley, John W. Hodge, Larkspur; Albert Frederick, A. L. Eickhorst and K. F. Coleman of San Francisco and F. D. Hatton of Monterey.

Officials of the Fresno Canal and Irrigation Company propose to extend the Enterprise Canal, which taps Kings River nine miles, at an approximate cost of \$60,000, for the purpose of irrigating 6,000 acres of land eight miles north of Fresno. The tract will be divided into small holdings. The complete irrigation system for watering the entire tract will cost approximately \$125,000.

Surprise Valley is to be irrigated in the near future with water furnished by the Modoc County Irrigation Company, which is building a large ditch from Cowhead Lake, ten miles east of Fort Bidwell, down the east side of the valley. This ditch will irrigate 20,000 acres of land. A great power proposition is also a part of the enterprise. A power-house will be located in the northeastern part of the county near Cowhead Lake. After the water passes through the power-house for the generation of electricity it will be carried in a large ditch for a distance of twenty-five miles down the valley.

COLORADO.

J. P. Lurton, engineer in charge of the survey work for the Pueblo Municipal Irrigation project, has completed the work of surveying the canal and reservoirs of the project. This system, when completed, will water 50,000 acres of land in the Boggs Flat district and the west portion of Pueblo county. The water will be derived from Pine Creek, Chalk Creek, Cottonwood Creek and Eagle River. To tap Eagle River a tunnel will be run through the mountain near the summit beyond Leadville. It will be a mile long and will divert a portion of the Eagle River from the western slope to the eastern slope. Reservoirs will be constructed for storage purposes and will have a storage capacity of about 75,000 acre feet of water. It is estimated that the project will cost approximately \$2,000,000.

Suit for \$12,000 has been filed against the Pueblo-Rocky Ford Irrigation Company and co-defendants by the Knowlton Construction Company, it being alleged that the defendants owe that sum on a contract for work on what is known as the Orlando Ditch.

It is announced that construction work on the Colt Irrigation project will be completed during 1912. This project contemplates the irrigation of 200,000 acres north of the river running from Fowler almost to Las Animas.

The Las Animas Consolidated Drainage District has issued bonds and improvement work will be commenced in the near future. This district includes 1,700 acres of land south of Las Animas and through the medium of this drainage system will be made some of the richest land in that section. The system will be tile all the way through. The tile will be 24 inches at the outlet and for a distance of 4,000 feet toward the upper end of the district, then reducing to 22-inch tile, and with further reductions in the laterals as will be required.

Repairs are being made on the Oxford flume west of Fowler. The directors have under consideration a permanent improvement. They propose to build a dam on either side of the flume, its entire length. The two parallel dams will be about two or three hundred feet apart and in time the sediment from the ditch will fill this so as to make a flume unnecessary. It is estimated that this permanent improvement could be constructed at a cost of \$20,000.

It is reported that between 80,000 and 100,000 acres of land will be brought under irrigation by a project which is to be undertaken by F. L. Harris of Lamar and other capitalists. The project will involve an expenditure of about \$4,000,000 and work will be begun in the near future. The district was created some time ago and the preliminary surveys have been made. The location of the

big reservoir site has been decided on. It will be on the Purgatoire river about 18 miles south of Las Animas.

The Pueblo County Commissioners have been asked to levy an assessment of 30 cents an acre against the 50,000 acres of land in the new county irrigation district which was established a few months ago. The first levy to be made against the land in the district will be for the engineering work and preparations for the bringing of water from the other side of the mountains to water the area.

The Bent County Reservoir Company has let the contract for the construction of a reservoir and canal system on Rule Creek. This project has been under way for several years and the system will eventually water 20,000 acres of land lying adjacent to the city of Las Animas.

Work on the boring of a tunnel 14,725 feet long through the continental divide under Jones Pass at the head of Clear Creek has been started. The tunnel will cost about \$589,000. Water will flow through it from the Williams fork of the Grand river into West Clear Creek and canals and thence into reservoirs. The area to be irrigated comprises 109,675 acres close to Denver. Farmers and landowners in the Henrylyn Irrigation district bonded their property at \$40 an acre and the Henrylyn Irrigation district bonded their property at \$40.00 an acre to build this irrigation system.

F. J. Hartman of Riverside and E. R. Hartman of Maher have taken over the holdings of the Paradox Valley Land and Irrigation Company and the private holdings of Paul S. Seeley, I. W. McConnell and C. G. Kinney, including water filings, reservoirs and 4,000 acres of land situated in West Paradox Valley. This land will be divided into small tracts and placed on the market by the recent purchasers.

Work on the Terrace Irrigation project near Monte Vista is being pushed with all possible speed. The contract calls for the completion of the project in time to water the lands next season.

MONTANA.

Government engineers have made a trip over the Flat-head Irrigation project and report that 40,000 acres of that land will be under completed canals and ditches by June 1, 1912.

A suit instituted by the Northwestern Trust Company of St. Paul, Minnesota, has been filed, in which this company seeks to foreclose a mortgage for \$150,000 given December 1, 1905, by the Miles City Canal and Irrigating Company.

Petitions are being circulated among land owners on the north side of Prickly Pear Valley for the creation of an irrigation district under the terms of the state law, and it is proposed to reclaim in the first unit between 6,000 and 8,000 acres. If this is successful additional units to the extent of 40,000 acres will be placed under irrigation. Water will be taken from Lake Hauser.

The Miles City Canal and Irrigation Company of Miles City has brought suit against 43 users of the water of the Tongue River to determine priority rights.

OREGON.

The American Surety Company has filed with the State Land Board a bond for \$50,000 as surety for the Portland Irrigation Company's undertaking to protect the state against the failure of that company to go ahead and complete the Chewaucan irrigation project within the specified period. The company is the new owner of the project which will eventually water 12,000 acres of land near Lakeview.

It is stated that a move is on to construct a gigantic irrigation project in northern Lake and Klamath counties. A company will be formed with the object in view of taking water from Lake Odell and by bringing it in cement-lined canals, irrigate the 350,000 acres lying in Christmas Lake and Silver Lake valleys.

(Continued on Page 24.)

Plow Without Leaving Ridges or Dead-Furrows.

The JOHN DEERE Two-Way Sulky Plow Best for Irrigated Lands, Sidehill Plowing, or in Dry Farming Sections

Here is a plow that leaves no dead furrows to fill up—no back furrows to drag down.

Start on one side, plow back and forth, finishing up on the other side—field left level.

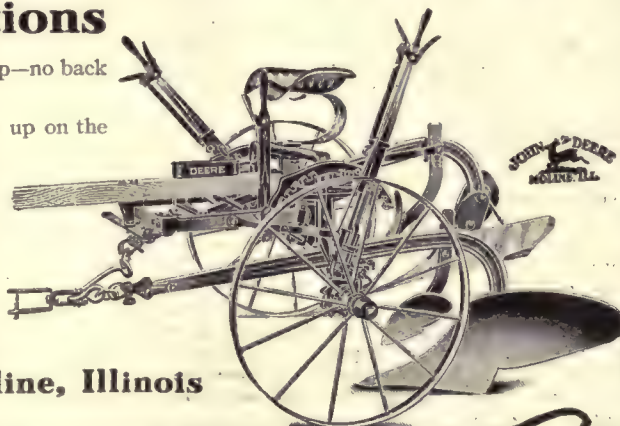
You can follow right after the plow with harrowing and seeding—no centers to plow out.

You can throw the dirt all one way on a side hill or plow irregular fields with no short "lands" to finish.

Lasts as long as two plows.

Write for booklet—free if you mention *Irrigation Age*

John Deere Plow Co., - Moline, Illinois



(Continued from page 14.)

by the enormous increase in the production of petroleum, most of which is used for fuel. The oil produced in California in 1910 aggregated between 65,000,000 and 70,000,000 barrels, which, on the basis of $3\frac{1}{2}$ barrels of oil for each ton of high grade coal, would be equal to a production of nearly 20,000,000 tons of coal.

The use of petroleum by the transportation and manufacturing industries of California has practically eliminated coal as a steam-raising fuel in the state. Oil is also used in the manufacture of gas, which is employed for cooking and for heating residences as well as for lighting. Oil is now also coming into use as a direct fuel for household purposes.

IMPORTANT NOTICE TO INTENDING SETTLERS.

Complaints have been received from settlers on reclamation projects that by reason of the misrepresentations of land agents they have been induced to purchase lands which were afterward found to be without any rights to water from the government canals. The Secretary of the Interior today issued the following warning which, while it refers particularly to the Rio Grande project in New Mexico and Texas, is equally applicable to other projects containing large areas of private lands:

"All persons are warned against accepting any statements concerning this project, without inquiry from the officers of the Reclamation Service. Experience has shown that some warning of this kind is necessary because misleading statements have been issued regarding the project and the conditions existing upon it. The project has many advantages and would not have been taken up and pushed unless it was considered feasible and worthy of development. These facts, however, do not warrant certain exaggerated statements which have been made.

"In particular, attention is directed to the requirements of the Reclamation Act regarding residence and cultivation. The act prescribes that no right to the use of water for land in private ownership shall be sold for a tract exceeding 160 acres to any one landowner, and that no such sale shall be made to any landowner unless he be an actual bona fide resident on such land or occupant thereof, residing in the neighborhood of said land.

"It is also required that the landowner shall reclaim at least one-half of the total irrigable area of his land for agricultural purposes before any right to the use of water shall permanently attach. Ignorance of these and similar requirements has resulted in great embarrassment to purchasers.

"It is not known how many years will be required for the construction of the storage dam, nor is it safe to make predictions as to when water will be available in view of the many uncertainties existing.

"Warning is also given that the amount of available water power has been grossly exaggerated in many current discussions. It is not definitely known that there will be any power available for sale, and there is no assurance that it will produce dividends reducing the cost of water rights.

"Purchasers are warned against being misled by the statement that certain tracts are 'signed up' under the government irrigation project. This 'signing up' is the landowner's subscription to the water users' association. It designates tracts of land and subjects to liability for water charges so much thereof as shall hereafter be furnished with water from the government works, but it does not in any way bind the government to furnish water in any particular tract. On the contrary, considerable areas have been thus designated in subscriptions to which, because of location, elevation, physical conditions, or other reasons, water can never be furnished. Prospective purchasers should not rely upon the statement that land is 'signed up,' but should carefully investigate and satisfy themselves that the tracts offered to them are in fact likely to be furnished with water under the project.

"While it is not possible to give definite assurance on many of these points, the persons interested are advised to read carefully the terms of the Reclamation Act or consult the publications such as 'Questions and Answers,' which have been prepared to explain some of the requirements of the law."

IMPROVEMENTS IN THE STATE OF WASHINGTON.

By AUGUST WOLF, 225 HUTTON BLDG., SPOKANE, WASH.

Official announcement will be made before the end of September by the Pacific Power and Light Company of its plans to develop 1,000,000 horsepower by hydro-electric installation in the Columbia river at Priest Rapids, southwest of Spokane, at a cost of from \$6,000,000 to \$10,000,000, according to advices from White Bluffs, Wash. It is estimated that from six to nine years will be required to complete the work.

The project includes the construction of an enormous dam across the river at the foot of the rapids, the face of the wall being 75 feet in height, or equal to the drop of the stream in a distance of nine miles; the building of the high line canal of the Hanford irrigation project, which the Pacific company owns, and the stringing of a network of transmission lines through the White Bluffs country, to supply power and light to a large part of eastern Washington.

A wing dam, diverting part of the current of the Columbia river from the main channel into a power canal is now furnishing electric power for the Pacific company at Priest Rapids. The use of this method of developing power will be continued until the larger dam is ready to take the load.

The measure recently passed by Congress, giving the Pacific company authority to dam the Columbia river, also provided for locks whereby navigation will be aided rather than hindered by the building of the dam. The lands under the present low line ditch of the irrigation project, and the proposed high line ditch, are being reclassified.

The construction of the Chicago, Milwaukee & Puget Sound Railroad from Beverly on the main line, 60 miles up the Columbia river from White Bluffs, has been delayed until the power company determines upon its plans and establishes its rights at the rapids. The railroad company made four surveys around the face of a rock wall 400 feet in height, and the line will now follow a 75-foot grade to keep above the level of the dam. To carry out this survey a cut will be made in the face of the rock wall for nine miles, one of the most expensive pieces of railway construction in the western country. The company has secured the right-of-way between Beverly and White Bluffs, and announcement has been made that grading will be started within 90 days.

(Continued from Page 23.)

S. H. Brown is installing a novel pumping plant on his farm, a half mile from Gervais. Mr. Brown has just completed a reservoir 14 feet in diameter and 35 feet in depth and through the bottom of this well he will have two 6-inch wells drilled. The plant consists of an 11 horsepower gasoline engine equipped with a pumping apparatus to pump 500 gallons per minute.

The Powder Valley Irrigation and Development Company of Baker has given a \$4,000,000 mortgage to the Union Safe Deposit Company of New York. This mortgage is given on 70,000 acres of land in Baker county, known as the Thief Valley project. This project will now be rushed to completion.

E. P. Hopson of the U. S. Reclamation Service is authority for the statement that the Government will spend approximately \$200,000 in Klamath county next year. The principal work to be done is to build a canal for irrigating lands in Poe Valley and a strip along the east side of Lost River is also to be supplied with water.

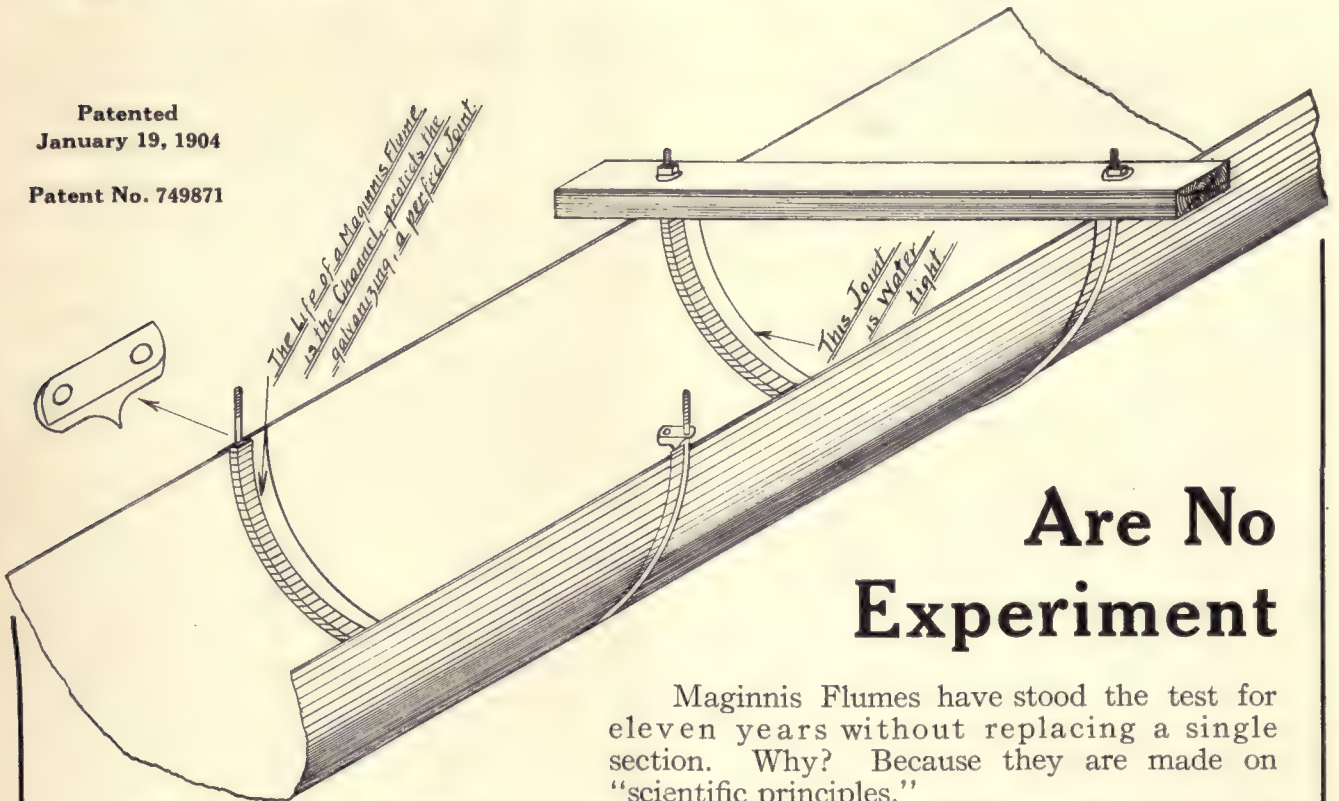
A proposition to carry out the project of reclaiming 27,004 acres of land in Crook county is being considered by the State Desert Land Board. The land lies on the west side of the Deschutes River near Laidlaw. The segregation was made on behalf of The Three Sisters Irrigation Company, which promised to reclaim the land with water from the regular flow of Tumalo Creek. This company

(Continued on Page 26.)

Maginnis Standard Galvanized Steel Irrigation Flumes

Patented
January 19, 1904

Patent No. 749871



Are No Experiment

Maginnis Flumes have stood the test for eleven years without replacing a single section. Why? Because they are made on "scientific principles."

The inner binder (which is part of the splice on the Maginnis flume) is made to check a silt in the bottom of the flume which protects the galvanizing. Without galvanizing a metal sheet will not last any longer than a stovepipe would if out in all kinds of weather.

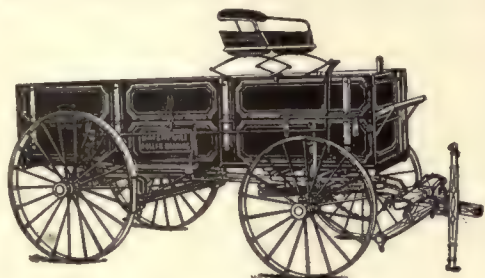
The life of the Standard Maginnis Flume is the Channel Binder, because of the protection given the galvanizing, not only by checking the silt but by checking the sand (which is more or less common to all irrigation water), which if permitted to travel through a flume with the same velocity as water would cut the galvanizing off and leave a plain sheet of metal. You know the results.

I am speaking from experience. To be exact, January 19, 1904, I received Patent Number 749871 for smooth inside flume. I, like a good many others, thought I had everything that was needed. At my own expense (not yours) I tried this flume out, more to determine the actual carrying capacity for measurements, etc., than anything else; to my sorrow I found that the sand would cut off the galvanizing when carried by the water through a smooth inside flume. I did not impose on my customers by putting this flume on the market, but continued to make the old reliable "MAGINNIS FLUME" which has now stood the tests for eleven years and given entire satisfaction.

A word about patents: I am the sole owner of the Maginnis Flumes patents, which were issued in 1902-1904 and cover inner and outer clamping members, inner binders, carriers rods, etc., in other words the only method of connecting two sheets of metal together and making them water-tight, without using rivets or solder. First used by P. Maginnis in experiments in 1901.

For further particulars address

P. MAGINNIS - - KIMBALL, NEB.



The Modern Wagon

BUILT OF STEEL

The only equipment that will stand the climate of the irrigated district, is made of steel. You know the reason. Wood dries out, becomes useless, and the machinery falls apart.

Davenport Roller - Bearing Steel Wagons

are THE wagons for the "Dry Farming" country. Not affected by the climate. Stronger, lighter draft and more durable; outlast several wooden wagons.

Built of steel I-beams, Channels and Angles, solidly riveted with large steel rivets, put in hot, making the gear parts practically one piece.

Nothing to Dry Out

No bolts to become loose and nuts to rattle off on account of parts shrinking or drying out. The DAVENPORT is constructed like the modern steel railroad bridge. Trussed and braced to withstand all strains. Built for the heaviest lifetime service.

No Tires to Reset

It makes no difference what the climate is, it does not affect the wheels on the DAVENPORT. They are made with a tension, each spoke carrying its share of the load all the time, whether it is on the top, bottom or side of the wheel. The spoke heads are countersunk in the tire; headed and shouldered in the hubs. The strongest wheels ever put on a wagon. No split felloes or cracked hubs. No repair bills to pay.

Roller Bearings



The Roller Bearing

30% to 50% Lighter Draft

It is a fact, that if it were not for the ROLLER BEARINGS, the automobile of today would be impossible. You know that ROLLER BEARINGS reduce the draft on machinery of all kinds. Here is your chance to get these advantages on

FARM WAGONS TEAMING GEARS
MOUNTAIN WAGONS LUMBER GEARS
TURN-UNDER WAGONS

Write NOW for all the information. Improve your farm by being able to do more work with the same horses and help. BE SURE and ask for PACKAGE NO. 45.

Davenport Wagon Company, Davenport, Iowa.

(Continued from Page 24.)

subsequently assigned its interests to the Columbia Southern Irrigation Company. This company was finally placed in the hands of a receiver and since that time the Oregon, Washington and Idaho Finance Company has obtained an option on the company's holdings.

One of the most interesting irrigation projects undertaken under the new Oregon law governing such enterprises will be voted on by residents of Yonna, Langell and Lost River Valley on November 21. The proposed district has been defined and official steps taken and approved by Judge Worden and other members of the County Court, to hold the election on November 21. It is expected to issue bonds to cover the cost of establishing an irrigation supply and owners of 20,000 acres which it is hoped to benefit are expected to vote favorably.

The Rapid Valley Irrigation & Development Company has secured a permit from the state engineer of South Dakota to appropriate 65 second feet from Rapid and Dry Creeks. The project embraces the irrigation for the present of 4,500, with an ultimate capacity of 10,000 acres. It is proposed to construct a large reservoir in Rapid Creek Valley below Rapid City to catch the flood waters which at present escape.

Plats for an irrigation system on the Cimarron River in Oklahoma have been filed in Oklahoma City by J. B. Traxler, E. C. Bell and Dr. Burnett of Lamar, Colorado.

About 4,000 acres of land lying adjacent to Tucson, Arizona, is to be irrigated by water taken from wells which will be sunk. This property is known as the Hart Ranch and was formerly owned by J. K. Brown of Tucson, who sold it to eastern capitalists who will put it under irrigation. Pumps will be put at the wells for raising water and they will be operated from a central power plant.

UTAH.

An irrigation project embracing more than 250,000 or more of arid land in Salt Lake, Utah, Rooele and Weber counties, has been launched and will be known as the Utah Conservation Company. The project comprehends the conservation of the flood waters of the Weber and Provo rivers. It is estimated that the project will involve an expenditure of from \$5,000,000 to \$10,000,000. The stockholders will be made up of prominent Salt Lake City men.

W. S. Rust and J. M. Lauritzen of St. George propose to construct an irrigation project about forty miles from St. George. The project is situated on the Utah-Arizona boundary line. The reservoir will be in Arizona and the lands in Utah. It is proposed to store the flood waters of Short creek, Cottonwood and Cane Bed canyons in the basin now occupied by the Short Creek Lake. Short Creek will be turned into the lake basin and a dam 15 feet high will be constructed about midway between the lake and the Short Creek Gap, by means of which 5,000 acre feet of water will be impounded.

The Farmers' Irrigation Company of Alexander, Watach county, have filed articles of incorporation with the secretary of state. The capital stock is \$40,000 in shares of \$5.00 each.

The Reclamation Service is rushing work on the Strawberry Valley Irrigation Project. A dam will be built which will divert the water of Strawberry River, which now empties into the Gulf of Mexico, into the basin of Great Salt Lake to irrigate 60,000 acres of land.

WASHINGTON.

A meeting of representative land owners living on the west side of the Okanogan River and Osoyoos Lake was held recently and an irrigation district formed. The plan is to put in a high line ditch, taking water from the Similkameen River. By placing the intake ten miles up the river all the higher bench lands, at present almost worthless, can be put under water.

When writing to advertisers please mention The Irrigation Age.

Three hundred thousand acres of land in the Horse Heaven country in Klickitat, Yakima and Benton counties will be reclaimed by a \$16,000,000 irrigation project. The Klickitat Irrigation & Power Company, who will reclaim this immense area, have already started construction work near Goldendale. The undertaking is financed by English and Canadian capital. The main canal, lined with concrete, will be twenty-five feet in width at the top, thirteen feet at the bottom, twelve feet in depth and 122 miles in length. The project includes five miles of tunnels, large storage reservoirs, dams and weirs. Five years will be required to complete the work. The land to be irrigated is owned by ranchers, who will pay \$60.00 an acre for the water rights in fifteen annual installments, the first being payable one year after water has been available for farming.

It is reported that the Chicago, Milwaukee & Puget Sound Railroad Company has purchased the holdings of the Hanford Irrigation & Power Company, comprising 200,000 acres of irrigable land in the upper Columbia Valley. This land will be irrigated and promoted by the Milwaukee road. There are at present 5,000 acres of land under irrigation in the vicinity of White Bluffs and Hanford which is watered by the original Hanford Canal. A high line canal will be constructed by the Milwaukee road which will add at least 100,000 acres to the land now irrigated.

The Shower Irrigation Company, with general offices at Walla Walla, has filed articles of incorporation. The company proposes to irrigate land in a new manner, that of throwing water in tiny streams from pipes laid along the ground. The capital stock of the company is \$25,000 divided into 250 shares.

MISCELLANEOUS.

The Mountain States Investment Company has been formed and will be incorporated in the near future, with a capital stock of \$2,500,000, and will develop two power sites in Carbon county, Wyoming, and reclaim 200,000 acres of land in the Encampment and Saratoga districts. It has not been definitely decided as yet where the main offices of the company will be located.

Kansas City capitalists have taken over a large area of land in Pecos, Brewster and Jeff Davis counties, Texas, and will at once begin the construction of a dam, by means of which 23,000 acres of land may be converted into a lake for irrigation purposes.

Milton Frease of New Underwood, South Dakota, has filed on nine second feet of water from Box Elder Creek, by which he expects to water 630 acres of land.

The government has started to repair the damages on the Carlsbad, N. M., irrigation project, caused by the heavy floods of last July, and is building stronger and better facilities for handling flood water. The cost of the work will be about \$50,000.

A dam and reservoir on the Nueces River will be built for irrigation purposes and will impound water to irrigate 12,000 acres of land lying near Amarillo, Texas.

The Washita Irrigation Company of Foss, Oklahoma, have filed articles of incorporation. Capital stock of the company is \$10,000. W. G. Cotter, W. F. Cantalon and W. S. Lawson, all of Foss, are interested in the company.

THE STORY OF BREAD.

The International Harvester Company, Chicago, has recently published a very interesting pamphlet entitled, "The Story of Bread." It contains 30 pages of reading matter, tracing the history of bread and modes of its manufacture down through the ages up to the present day. The pamphlet is fully and tastefully illustrated and will be sent free to all who apply for it. Address International Harvester Company of America, Chicago, U. S. A.

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Send one dollar for a year's subscription to the Irrigation Age. Once a subscriber always a subscriber.

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WITH WHICH IS MERGED

The Chicago Irrigation Association

AND

The American Irrigation Federation

This Federation is organized for the promotion and encouragement of the irrigation, reclamation, colonization and development of land within the United States of America. It maintains an office at 1110 First National Bank Building, 38 South Dearborn Street, where there is open to the public, free of charge, maps and publications relating to the lands of the United States. Questions relating to irrigation matters will be answered by the officers of the Federation and information given.

THE OFFICERS OF THE FEDERATION ARE:

EDMUND T. PERKINS, President
HENRY C. WOOD, Vice-President
D. H. ANDERSON, Secretary
WILLIAM W. VERNON, Treasurer

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PARKE WEST, Journalist
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Organizations and individuals interested in reclamation are invited to become members. Detailed information concerning initiation fees and dues will be furnished upon application to the secretary. Address

D. H. Anderson, Secretary

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automatically
day and night



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INSURES your crop against **DROUTH**
Our experience in 1910 and 1911 has proved
that good crops can be grown with less than
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Combination Price \$3.00

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When you write ask about the **CAMPBELL COR-
RESPONDENCE SCHOOL.**

(Continued from page 20.)

store the floods, reclaim the deserts, make homes on the land."

The personnel of the National Irrigation Congress will be as follows: The officers of the congress, the president of the United States, the vice-president of the United States, the members of the cabinet, members of the United States senate and house of representatives, governors of states, territories and insular possessions of the United States, members of the federal, state, territorial and insular irrigation, water and conservation commissions, state engineers and commissioners of agriculture and horticulture, the mayor of each city or town having a population of over one thousand, chairmen of general and special committees, all permanent delegates of the congress.

Delegates will be appointed under the provisions of the constitution as follows: Fifteen delegates appointed by the governor of each state or territory; ten delegates appointed by the mayor of each city of the United States of more than twenty-five thousand population; five delegates appointed by the mayor of each city in the United States of less than twenty-five thousand and over one thousand; five delegates appointed by the chairman of each board of county commissioners or county supervisors in the United States; two delegates appointed by the mayor from each incorporated town having a population of less than one thousand; two delegates duly accredited by each regularly organized society devoted to irrigation, agriculture, horticulture, and engineering; two delegates regularly accredited from each college and university; two delegates duly accredited by each chamber of commerce, board of trade or commercial club.

Appointment of delegates should be made as early as possible to facilitate the organization of state delegations. Notices of appointment giving full name, post office address and occupation of each delegate should be forwarded to the secretary of the National Irrigation Congress at Chicago.

(Continued to page 30.)

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To sell highest grade irrigated fruit land in the country. Exceptionally attractive selling terms. This is the best paying proposition today for land men who are live wires in all sections of the country. Address **ROBERT S. LEMON**, General Sales Manager, Bitter Root Valley Irrigation Company, Suite 848-898 First National Bank Building, Chicago.

3,300 MILES OF DRY FEET!

Sixteen million rubber boots, arctics, overs and other articles of the famous "Ball-Band" Footwear, protect sixteen million feet in cold, muddy, snowy or slushy weather.

These sixteen million articles of "Ball-Band" Footwear, placed heel to toe, would make a continuous line of more than 3,300 miles—a dry walk from New York to San Francisco, with an additional line of a hundred miles or so along the coast.

Many of our readers are among the eight million wearers of "Ball-Band Rubber and Woolen Footwear. They are familiar with its popularity, but few realize what an enormous volume of manufacture is necessary to meet the demand. Figures recently obtained from the factory are most interesting.

1,252 carloads of raw material, supplies, etc., are required to make one year's output of "Ball-Band" Footwear. This material if put into one continuous train, forming a hollow square, would enclose more than 3,600 acres with a solid wall of fully-loaded freight cars.

5,000,000 square yards of sheetings, cotton duck, cashmerette, wool linings, etc., were used in these goods—enough cloth to cover 1,033 acres completely.

In 1910 "Ball-Band" dealers received 1,030 carloads of finished footwear, aggregating over \$10,500,000. These shipments would make another train, solidly enclosing 2,500 acres.

That quality wins has been proved by the manufacturers of "Ball-Band," as these stupendous figures show. The company's policy is summed up in the declaration that "This company has not, nor will it ever cheapen the quality of its goods to meet competition."

The Red Ball trademark has come to be the recognized symbol of quality in rubber boots, and other heavy rubber and woolen footwear. Forty-five thousand dealers in all parts of the country sell "Ball-Band" goods. If any reader fails to find them he is invited to write the Mishawaka Woolen Mfg. Co., at Mishawaka, Indiana, mentioning his dealer's name and the company will see that he is supplied.

New Irrigation Project

The Western Land and Irrigation Syndicate of McGill, Nevada, has received its water permit for 15,000 acre feet per second and has segregated 5,000 acres of land in the Steptoe Valley, on the Nevada Northern R. R., under the Carey Act.

Work on this project will be started immediately and bonds will soon be issued to complete the entire construction work. For particulars write,

SECRETARY

WESTERN LAND AND IRRIGATION SYNDICATE,
Box 488 **McGILL, NEVADA**

Old Uncle Sam is still giving away land to his citizens

There are millions of acres of good government land in all parts of the West which are open to entry to any American citizen. **You, if an American Citizen, are entitled to 160 acres or 320 acres of government land.**

Do you know where and how to get it?

Western World

For 10 years the Standard American Publication for Homeseekers, Land Buyers and Investors, will answer these questions for you.

It has made a sweeping reduction in its subscription price; **the price is now 50 cents a year—3 years for one dollar.**

Send Fifty Cents for a year's subscription and we will give you **absolutely free** your choice of **Hammond's Handy Atlas of the World** or **The American Settler's Guide.**

Address and make all remittances to

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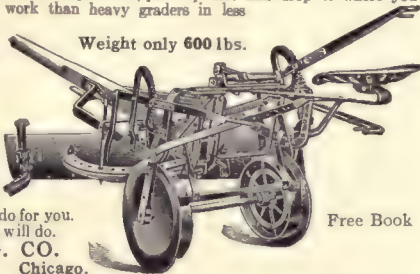
Solves Your Irrigation Problems. This light weight, all steel, one man machine will cut ditches from 24 to 36 inches deep at a cost of 2 cents a rod and grade roads, clean streets, cut brush, stir your soil, pick up dirt and drop it where you want it. Will do more work than heavy graders in less time at less cost.

One man with two or four horses operates it. It is a perfect combination of several expensive machines and will save its cost over and over again.

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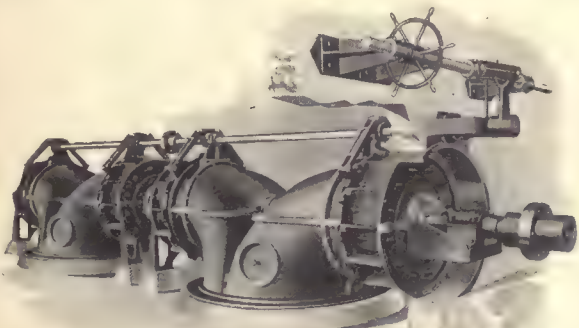
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*Write for the book
—it costs you
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THE OHIO ROAD MACHINERY COMPANY
OBERLIN, OHIO

(Continued from page 28.)

While the policy of the congress is shaped at each session by the state delegations the continuity of the organization and the efficiency of its work are influenced largely by the permanent delegates provided for by Article VI, Section 2, of the constitution; and members interested in the permanency of the congress are earnestly invited to become permanent delegates.

All foreign governments have been invited to send representatives to the congress. The hearty responses from foreign governments at previous congresses have made the foreign representation an important feature of the organization. The increasing interest promises large representation this year.

The program will include addresses and papers by experts in irrigation, drainage and forestry; foreign delegates, governors of states and territories, senators and representatives in the federal congress, public officials and eminent citizens, statesmen and scientists, industrial and financial leaders, officials of federal and state irrigation projects, officials of private irrigation enterprises, leaders in drainage reclamation and others.

It is planned to make this a practical, live congress, and to secure the desired results from the consideration and discussion of the questions in which the delegates are interested, it is necessary that the delegates come prepared to discuss briefly and to the point the questions which come before the congress. Discussion is an important feature of the program and will be encouraged.

The governor of each state and territory in the Union, together with his staff, has been invited to be present on Governors' Day, for which a session of the congress will be set apart.

No previous congress has offered the many opportunities afforded by the coming nineteenth meeting.

Chicago is the center of a vast territory with millions of people "land hungry" and eager to learn of opportunities to secure homes on the land. The congress will tell of the wonders accomplished through reclamation and

Mayer HONORBILT SHOES



These are the shoes that "stand the racket"—have great wearing service, perfect fit and are very comfortable.

Mayer Honorbilt Shoes are built on honor. Made of the finest grade leather—specially selected for its durability, toughness and pliancy.

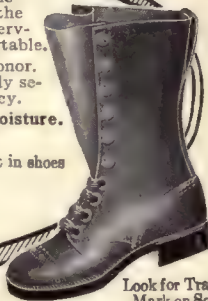
The leather is treated to keep out water and moisture.

Wear Mayer Honorbilt fine shoes for dress-up occasions.

Made in many styles and all heights. If you want the best in shoes insist on the genuine Mayer Honorbilt.

Sold by dealers—if you cannot find a dealer, write to us. Look for the Mayer Trade Mark on sole.

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Look for Trade
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The control, regulation, and economical distribution of your water supply depends upon the adaptability, power and convenience of your headgate lifts. When not properly designed and made, lifts lack power to handle headgates under any and all conditions. If lifts are difficult to operate, or do not permit quick and close adjustment, it means loss of time which, during the irrigating season, is often as valuable as the water itself.

Making a specialty of headgates and headgate lifts, and having special patterns and machinery for their manufacture, I can furnish headgates and lifts especially adapted to individual requirements, and can quote close prices.

My complete Catalogue shows Northwestern Headgate Lifts for gates of any kind, any size, for any purpose, and any pressure.



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the great work remaining to be done. Ocular demonstrations of the truth will be found at the United States Land and Irrigation Exposition at the Coliseum, November 18 to December 9.

Provision has been made for giving exceptional attention to drainage, both in connection with irrigation projects and for the reclamation of swamp and overflow lands in the humid as well as in the more arid portions of the country. The International Live Stock Exposition will be held December 2 to 9. The Chicago Grand Opera will delight and entertain the music lovers. The great city will be in holiday attire in fitting celebration of the wonders accomplished through the Chicago spirit "I Will."

Delegates should notice particularly the opportunity this trip will give to visit numerous places of national interest. Full information can be secured from the secretary of the National Irrigation Congress at Chicago and during the time of the congress an information bureau will be conveniently located for the benefit and information of delegates and visitors.

It is desired to enroll you as a fellow laborer in the great constructive work to which the congress is dedicated.

USE OF BURLAP ON THE IRRIGATION LATERAL.

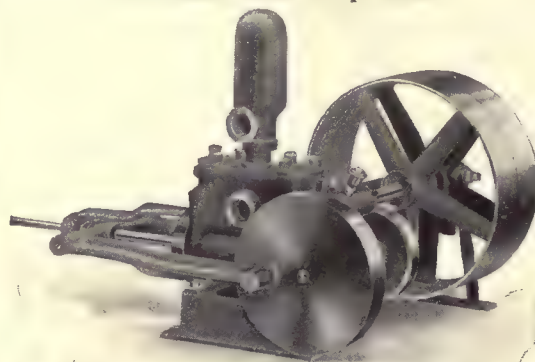
A newly made lateral, with loose earth embankment on the lower side, is very easily damaged should the water be turned out over the soft banks successfully. Water may be diverted over these loose earth embankments if a piece of burlap or canvas is made fast to one end on the inside of the lateral and the other end to fall outside. This will serve to protect the banks and, as the water is flowing out, its weight will hold the burlap in place.

If your lateral seems to cut badly in the bottom at any place, you may be able greatly to reduce this by taking burlap and lining the bottom and sides. The burlap can best be held in place by several slender stakes driven in the bottom and sides of the lateral.

If your embankment slips out, causing a break, this

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Irrigation Pumps and Cylinders a Specialty

Illustration shows our shallow well Power Pump, but we make a complete line for deep wells in a variety of sizes.

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are sprayers of quality. Winners of the gold medal in the spraying machine contest held by the National Horticultural Congress at Council Bluffs, Iowa, November 10th to 19th, 1910. Sprayers for every purpose—Hand or traction power. If you grow one or one hundred acres of fruit or field crops, you need a Hurst Sprayer.



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HARD, uncomfortable, unhealthy work—irrigation—*unless* you have perfectly dry, easy-fitting rubber boots—boots that you can wear all day without knowing it.

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are easy-fitting and long-wearing. They are the latest and best product of the Woonsocket Rubber Co., which has been famous for 45 years for the quality of its rubber boots. Woonsockets have always had the reputation of being the best rubber boots made, and the *Elephant Head* is the best Woonsocket Boot. Any dealer.

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which appears also on all our shoes.

WOONOCKET RUBBER CO.
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may be successfully closed by using small burlap sacks filled with earth and laid in such a manner as to stop the flow of the water. If there is not too much water flowing, the break may be stopped, it not being necessary to turn the water out of the lateral for repairs.
—R. L. Parshall, Colorado Agricultural College, Fort Collins.

QUALITY OF KANSAS WATERS.

In its publication of the results of studies of the water resources of the country the United States Geological

WITTE ENGINES

GAS—GASOLINE—DISTILLATE—NAPHTHA

Do the work at average cost of **One Cent** per horse power hour. Immense saving by our method of "pre-heating" the fuel. Built so perfectly that repairs cost less than \$1 per year average. Every valve is **vertical** and will not wear on the stem or slip inside. Freezing cannot injure bed as **cylinder and base are separate**. Hammered steel cranks, cut gears, etc.

GUARANTEED FIVE YEARS

We are experts in engine building; have done nothing else for twenty-six years. Our reference is thousands of satisfied customers. Our prices are right. All sizes, 2 to 40 H. P. Special inducements to introduce in new localities.

Write for free catalog stating size wanted.



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Send \$1.00 for The Irrigation Age one year, and The Primer of Irrigation

PAYS FOR ITSELF IN ONE MONTH



and Keeps on Saving You Money at the Same Rate Thereafter.

THE RECLAMATION DITCHER

Cuts Canals and Laterals for Less than any other machinery—because it plows the dirt out with **One Continuous Sweeping Motion**.

We guarantee the cost per yard and prove it before you buy.

THE ADAMS DITCHER CO.
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Delays Pay No Dividends.

Mail This Coupon Today.

The Adams Ditcher Co., Indianapolis, Ind.

Below are descriptions of our proposed ditches. What will it cost per cubic yard to make them with the Reclamation Ditcher?

Length	Width	Average Depth	Maximum Depth	Minimum Depth	Slope of Sides	Character of Soil

Name _____

Address _____

When writing to advertisers please mention The Irrigation Age.

Survey has just issued Water Supply Paper 273, a large volume descriptive of the water supplies of Kansas, by H. N. Parker, with an accompanying preliminary report on stream pollution by mine waters in southeastern Kansas, by E. H. S. Bailey. The work incident to the preparation of the report was done in co-operation with the Kansas State Board of Health.

The geology and underground waters of Kansas are discussed at some length, as well as the surface waters of the various rivers and creeks of the state. The report also contains a discussion of the quality of the under-ground waters of each of the 104 counties in the state, and includes a large number of chemical analyses of water, both surface and underground. The report should be of no little interest and value to the people of Kansas, both individually and collectively. A copy may be obtained free of charge on application to the Director of the United States Geological Survey, Washington, D. C.

ARE YOU SAVING YOUR ALFALFA SEED?


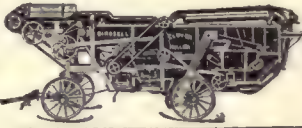
**You may be losing thousands of
Dollars each Year.**

Everybody knows there's money in Alfalfa if properly grown. Alfalfa growers do not seem to realize the importance of saving one crop each year for seed. Alfalfa seed is in great demand and you can have a yield of from 2 to 6 bushels per acre per year.

Write for our Alfalfa Booklet—FREE. It is written by Prof. J. M. Westgate, U. S. Dept. of Agriculture, Washington, D. C.

We had Prof. Westgate compile this booklet especially for those interested in growing Alfalfa for seed and hay. We are interested in the Alfalfa Seed Question because we are the only manufacturers of a machine built especially for hulling and cleaning Alfalfa Seed. The Booklet however, deals with Alfalfa only and contains nothing concerning our machinery. Write for it today.

BIRDSELL MANUFACTURING CO.,
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Ambursen Hydraulic Construction Company, Engineer-Constructors

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88 Pearl St., Boston, Mass.

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405 Dorchester St. West, Montreal, P. Q.

IRRIGATION IN Northeastern Colorado

The farmers in this district are irrigating their lands by the pumping system, power for running the pumps being supplied by electric companies who have their power lines well distributed over the country. The cost is nominal. By this system the water supply can be positively controlled and crops are assured. This district is served by the

UNION PACIFIC

**STANDARD ROAD OF THE WEST
PROTECTED BY ELECTRIC BLOCK SIGNALS**

Our folder, Farming in Northeastern Colorado, telling of the work and possibilities in this district, will be sent on request.



**GERRIT FORT,
Passenger Traffic Manager,
OMAHA, NEBRASKA**

THE LENNON METAL FLUME

PATENTED

Nothing Newer, More Efficient nor Economical in Flume Construction



One of Our No. 98 Flumes Erected for the Stratton Estate, Colorado Springs. Capacity 40 Cubic Feet Water per Second on a Grade of Five Feet to the Mile.

¶ No wooden cross bars to catch drifting weeds, etc., and undermine trestle work by overflowing. ¶ No expense in boring holes in cross bars or other labor of erection. ¶ Do not leak. ¶ Made in any size and any length. ¶ Both smooth and corrugated. ¶ Made from both American ingot iron and special acid resisting steel. ¶ Steel trestle work for flumes erected. ¶ Write for literature and prices.

Manufactured by

The Colorado Ingot-Iron Pipe & Flume Company

Corrugated and Smooth Pipe, Syphons, Flumes, Headgates, Arches, Steel Trestle Work, etc.
COLORADO SPRINGS, COLO.



Irrigation Increases the Productive Capacity of the Soil

Colorado presents the development of the highest type of irrigation.

IRRIGATION has a tendency to produce more compact communities and a larger circle of neighborly life.

The Colorado farmer produces scientifically and economically and with no waste of effort.

These Reasons Account for the Western Migration of Farmers

Our publications devoted exclusively to the agricultural resources of Colorado and Wyoming along our lines describe fairly and thoroughly the results of "FARMING BY IRRIGATION."

WRITE TODAY FOR BOOKLET

T. E. FISHER, General Passenger Agent, Colo. & Sou. Ry., Denver, Colorado

IRRIGATION SYNDICATE GETS WATER RIGHT PERMIT.

The Western Land and Irrigation Syndicate has received notice from the state engineer that the permit for their water right has been granted.

The company is now in a situation to safely go ahead on the construction work of its dams and ditches.

The permit calls for 15,000 acre feet of water which is to be reservoired by a dam across Steptoe Slough north of the Young ranch at Melvin or Warm Springs, Nevada.

In expectation of the issuance of the permit the company at its last few meetings has been planning to put its engineer, J. N. Wattson, in the field to make the surveys necessary for the work.

Five thousand acres of land have been withdrawn by the United States under the provisions of the Carey Act

from entry and have been set aside to be irrigated by our local company.

The work will be done under the inspection of the State Engineer's office, the first work will be done before November 10, 1911.

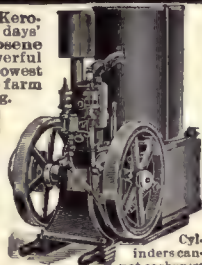
This project will furnish farms for many families, and it is one of the pioneers in the field in the state of Nevada, where the irrigation projects under the provisions of the Carey Act are but started. While other western states for the past few years have irrigated thousands of acres under this act, Nevada has done nothing on account of the faulty laws during this time. Since the enactment of new laws by the state during the two last Assemblies, Nevada will have the opportunity to develop thousands of her fertile acres, and it is to be hoped that the project of the Western Land and Irrigation Syndicate is but a forerunner for other similar projects in White Pine county.

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Amazing "DETROIT" Kerosene Engine shipped on 15 days' FREE Trial, proves kerosene cheapest, safest, most powerful fuel. If satisfied, pay lowest price ever given on reliable farm engine; if not, pay nothing.

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Automobile owners are burning up so much gasoline that the world's supply is running short. Gasoline is 3c to 15c higher than coal oil. Still going up. Two pints of coal oil do work of three pints gasoline. No waste, no evaporation, no explosion from coal oil.



Amazing "DETROIT"

The "DETROIT" is the only engine that handles coal oil successfully; uses alcohol, gasoline and benzine, too. Starts without cranking. Basic patent—only three moving parts—no cams—no sprockets—no gears—no valves—the utmost in simplicity, power and strength. Mounted on skids. All sizes, 2 to 20 h.p., in stock ready to ship. Complete engine tested just before crating. Comes all ready to run. Pumps, saws, threshes, churns, separates milk, grinds feed, shells corn, runs home electric-lighting plant. Prices (stripped), \$29.50 up. Sent any place on 15 days' Free Trial. Don't buy an engine till you investigate amazing, money-saving, power-saving "DETROIT." Thousands in use. Costs only postal to find out. If you are first in your neighborhood to write, we will allow you Special Extra-Low Introductory price. Write Detroit Engine Works, 371 Bellevue Ave., Detroit, Mich.

For Father, Son, Brother, Uncle, Nephew or Grandpa

\$5.00 Safety Razor for only 97 cents



Beautifully silver plated, with stropper, handle and holder, a full set of Grains Celebrated Wafer Blades, all in a handsome lined leather case, just like the high grade \$5.00 outfits sold in stores. Remember this special Advertising Offer is for a short time only in order to introduce in every city, town and hamlet in the United States.

All you need to do is to refer to this ad, enclosing ninety seven cents, with your name and full address and the complete Grains Safety Outfit, exactly as described will be sent at once fully prepaid.

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Send \$1.00 for
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Provide yourself with "BALL-BAND" Rubber Boots NOW, and thus make sure that your feet will be dry and comfortable through all the wettest, coldest weather of the season.

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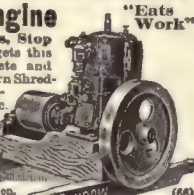
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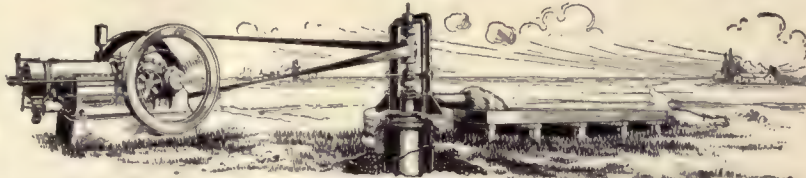
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For Fuel Is Claimed by Users of These Engines



Fairbanks-Morse Oil Engines operate on low grade oils, at about 2 cents a gallon at refinery. These engines are reliable, easy to start, easy to care for, durable, and always develop more than their rated power. Now giving satisfactory service in all the irrigation fields. Sizes up to 200 H. P.



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They have many real advantages in strength, simplicity, capacity, and durability. They are equipped with a compound lever and a toggle joint plunger, which gives them their great compressing power. A 500-pound pull on the sweep of a 16x18 I H C press gives 76,800 pounds pressure in the bale chamber. The bed reach is only about 4 in. high and very narrow. The bale chamber is very low—easy to reach over when tying the bale.

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I H C Service Bureau

The Bureau is a center where the best ways of doing things on the farm and data relating to its development are collected and distributed free to everyone interested in agriculture. Every available source of information will be used in answering questions on all farm subjects. If the questions are sent to the I H C Service Bureau they will receive prompt attention.

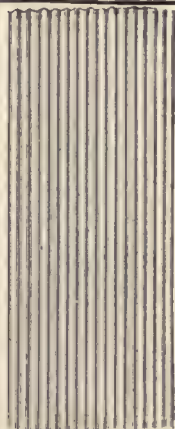
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From 2½ in. outside diam. 52¢ per foot
To 6½ in. outside diameter. 35¢ per foot

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Konkrete Block Machine, complete for making 8x8x16-inch blocks. Weight, 175 pounds. Price.....\$13.85

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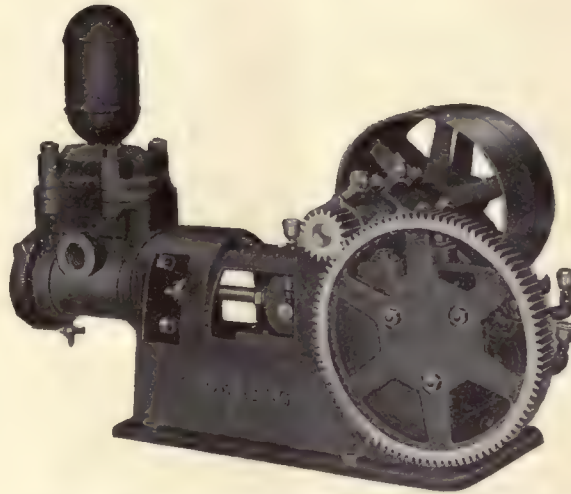
\$1.95 Buys this strong, well made painted sash door, size 2 ft. 6 in. x 6 ft. 6 in. Glazed with double strength clear A glass, size 22x38. We have on hand thousands of these doors, windows and mill work of all kinds. Special mill work to order. Screens, Storm Sash, Interior Finish of all kinds, Mantles, colonnades; all brand new stock, guaranteed manufacture at prices that are positively the lowest of all low prices. When comparing our prices with others, compare the quality too. You will find our prices the lowest and the quality as high as the highest.

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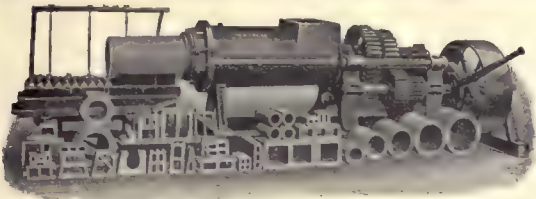
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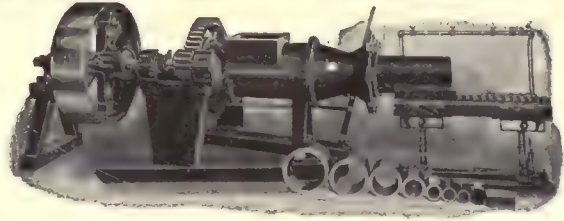
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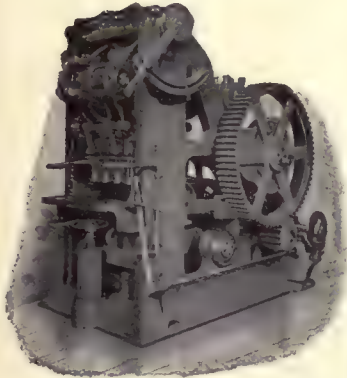
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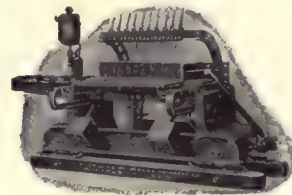
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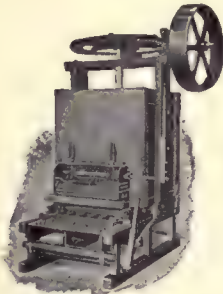
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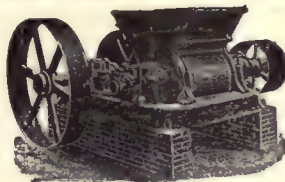
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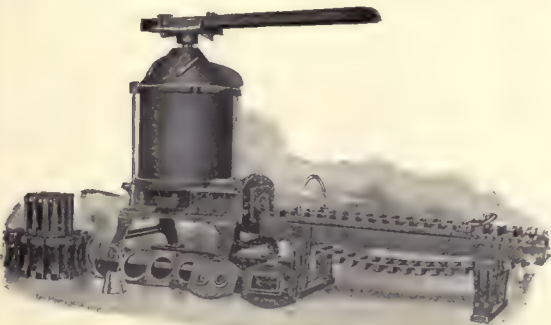
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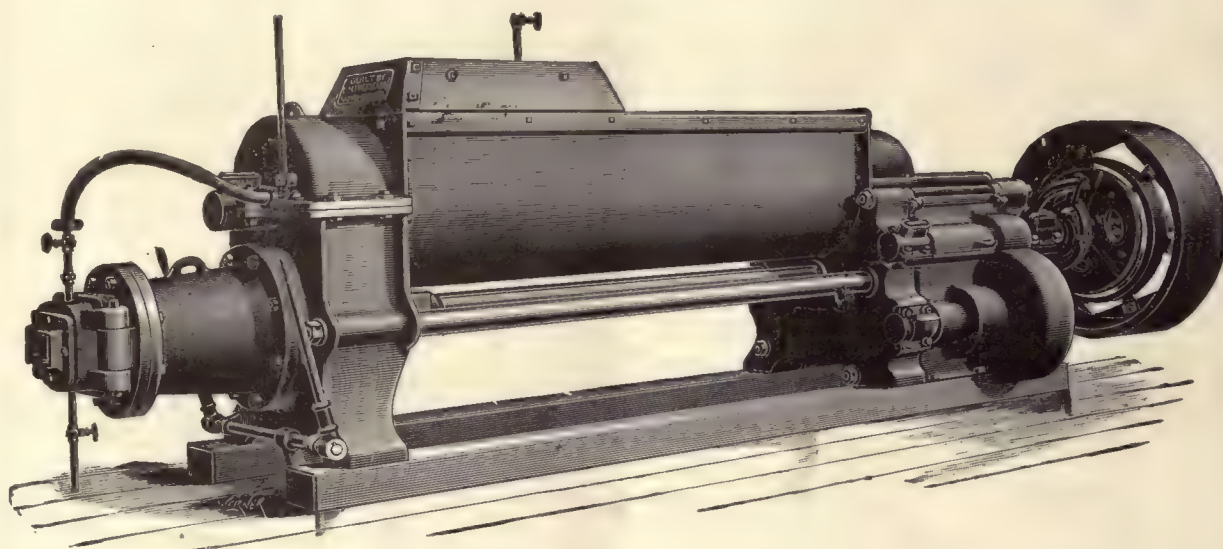
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UNION PACIFIC STANDARD ROAD OF THE WEST PROTECTED BY ELECTRIC BLOCK SIGNALS

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and Keeps on Saving You Money at the Same Rate Thereafter.

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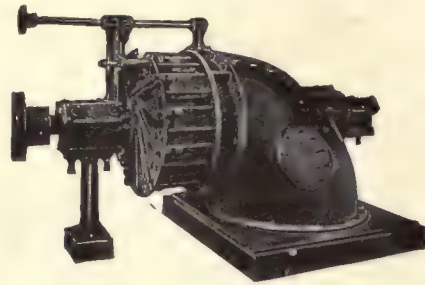
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When the PUMP cannot be direct connected to the turbine shaft, the power is usually transmitted by gears, shafting, etc. On account of the **HIGH SPEED** of the SAMSON, for a given power, lighter and consequently **CHEAPER** transmission machinery can be used.

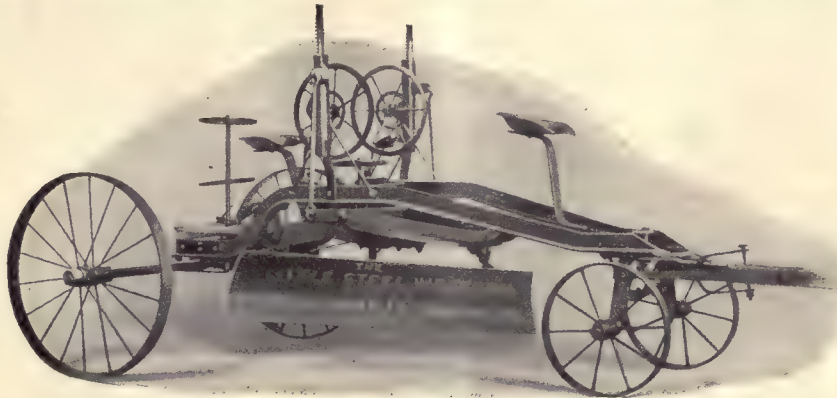
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5. It has **FOUR** wheels which are **ESSENTIAL** for even work and light draft.

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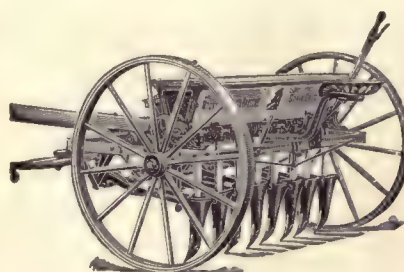
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The *Irrigation Age* has established a book department for the benefit of its readers. Any of the following named books on Irrigation and Drainage will be forwarded, postpaid, on receipt of price:

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Irrigation Engineering, Herbert M. Wilson.....	4.00
The Primer of Irrigation, Anderson.....	2.00
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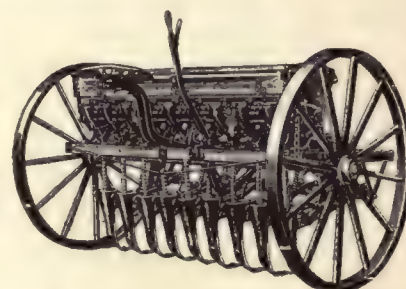
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THE IRRIGATION AGE

VOL. XXVII

CHICAGO, DECEMBER, 1911.

No. 2

THE IRRIGATION AGE

With which is Merged

MODERN IRRIGATION
THE IRRIGATION ERA
ARID AMERICA

THE DRAINAGE JOURNAL
MID-WEST
THE FARM HERALD

D. H. ANDERSON
PUBLISHER,

30 No. Dearborn Street, - - - CHICAGO
Old No. 112 Dearborn St.

Entered as second-class matter October 3, 1897, at the
Postoffice at Chicago, Ill., under Act of March 3, 1879.

D. H. ANDERSON, Editor

ANNOUNCEMENT.

"The Primer of Irrigation" is now ready for delivery. Price,
\$2.00. If ordered in connection with subscription, the price is \$1.50.

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America. D. H. Anderson, Secretary.

Official organ of the American Irrigation Federation.
Office of the Secretary, 212 Boyce Building, Chicago.

Interesting to Advertisers.

It may interest advertisers to know that The Irrigation Age is the
only publication in the world having an actual paid in advance
circulation among individual irrigators and large irrigation corpo-
rations. It is read regularly by all interested in this subject and has
readers in all parts of the world. The Irrigation Age is 27 years
old and is the pioneer publication of its class in the world.

Important Rulings on Government Projects.

A ruling by Secretary Fisher recently made
regarding the relinquishment of portions
of land that settlers are unable to pay for
is of great interest to all those who have
taken up land on the Government irriga-
tion projects. It provides that if such
homesteaders have taken up more land than they are able to
pay for they may release a certain amount of such land
taken up and get credit for all payments previously made on
their final holdings. This is a move in the right direction,
as it will encourage the man of moderate means to venture
upon a Reclamation project and try to work the maximum
allowable acreage; should he fail to succeed after faithfully
trying, the money paid down will not be lost, but will be
credited as paid on the smaller retained acreage; for instance,
a man takes up 80 acres but finds after a year or two he is
unable to work more than 40 acres; then he can release 40
acres and the payments made previously on the original 80
acres will be credited to him as paid on the retained 40 acres.
And should he find after further honest efforts that 40 acres
is still more than he can farm to the best advantage he will
be permitted to release another portion of that land, receiv-
ing credit for all payments as applied to the retained portion;
then subdivision may be made to a minimum of 10 acres.

Under this ruling no settler need to lose either his hold-
ings and payments made thereon as was formerly the case,
when a settler lost everything through cancellation for non-
payment of charges.

It is evident that Secretary Fisher is taking the right
course in this matter and that present settlers as well as

prospective ones will feel in much better condition to take up the practical work of reclamation.

Another important ruling for the benefit of present settlers was recently made by Secretary Fisher extending the time in which settlers may pay overdue payments on entries; the payments which were due the Government March 1, 1911, have once been extended to December 1, 1911, but quite recently this time has been further extended to March 15, 1912.

These two rulings show that the administration intends to assist bona fide settlers as far as possible and in permitting entries to as small an amount as 10 acres is decidedly favoring intense farming which in the course of time will become an actual necessity.

This will enable the man of moderate means to work a small farm with good prospects of success.

**Do Not
Neglect to
Purchase
This Book.**

"The Primer of Hydraulics," of which another installment appears in this issue, will be ready for delivery about the end of the month of January, 1912. There is no other book on the subject of hydraulics on the market today that treats this difficult applied science in as clear and practical way as the book referred to. It is gotten up by a practical engineer with large experience in Hydraulics, Drainage and Irrigation, and the book consequently relates to practical problems from these three fields of application. The work is handled in a progressive style, building the more advanced ideas upon simpler ones so that the observant and careful student can master the subject with little difficulty by just following the author and by working the problems which are used as an illustration of the principles involved.

In addition to the splendid and clear text which is profusely illustrated with examples and diagrams the books contain a large number of valuable tables, many of them which have never before been published.

Perhaps the principal reason why this book should appeal to our readers is the fact that a college education is not required to understand and make use of the book. A man with an ordinary grammar education can, by studying this book, become readily proficient in its use and able to analyze the various problems in Hydraulics, Irrigation and Drainage and solve them by the aid of the "Primer of Hydraulics."

Please see announcement elsewhere in this issue how to obtain this valuable work.

**The
Compliments
of the
Season.**

The present issue of THE IRRIGATION AGE will be the last one before the advent of Christmas and New Year, and we consider it therefore timely and proper that we should on this occasion extend to our many thousands of readers a cordial greeting and the wish of a Merry Christmas and Happy New Year.

The custom of merry-making and festivities at this time of the year has been brought down to us from time immemorial. It cannot be deduced from the fact that the month of December is in the winter, or rainy season, since the inhabitants of the Southern Hemisphere are entering into their summer season at this time; there may be, of course, a greater zest shown on the Northern Hemisphere at this season on account of the wintry conditions tending to give the people more time to celebrate and entertain each other. But wherever the Christian religion is known the thoughts of all turn to that historic and interesting period when the

Child Jesus lay in the manger at Bethlehem and when the heavenly host chanted the message on high: "Peace on Earth, Good Will to Men."

Thus it behooves us as the holiday season approaches to reflect upon the meaning of that splendid lesson taught in the above quotation. It expresses a most beautiful sentiment, the brotherhood of man and the fatherhood of God; a religious idea in which all nations may unite with perfect harmony and which if put into practical execution will do more toward the establishment of permanent peace in the world than all the congresses or other agencies ever convened. It teaches the golden rule, which is by all odds the best guide for all our actions toward our neighbor and we can at this time do nothing better than to resolve that we will do "unto others as we wish them to do unto us."

**Irrigation
Necessary
in the
Middle West.**

There is no mistaking the fact that the rain-fall alone cannot be depended on for the raising of full crops in the states west of the Mississippi, as the many crop failures of recent years have abundantly proven. It is not only the point of insufficient precipitation, but more particularly the fact that rain is often too abundant when not wanted and that there is none at the particular time the growing crops need water the most. Thus, to counteract the influence of droughts the introduction of irrigation is necessary and strongly recommended. Nor should this be limited to the states west of the Mississippi river as there occur cases in almost any other state of the union where intermittent irrigation at the right time would frequently turn crop failures into successes. The very fact that a farmer has on his land facilities to water his crops any time he wishes is a tremendous advantage which greatly enhances the value of the land and permits of intensive farming.

That the time is ripe when farmers in general must take up the subject of providing for a supplementary supply of water for their work is fully admitted and the discussions of methods is therefore in order. As a general proposition the irrigation problems of the East are very much different from those of the West and consequently require different treatment. In the West the projects cover large areas and the reclamation works necessary are of great magnitude; many of which take care of millions of acres.

In the Eastern and older states the establishment of successful irrigation on a large scale is more difficult, on account of the settled character of the country. It is necessary that each individual farmer, or perhaps several whose land and cropping methods require similar treatment, combine and evolve a satisfactory system which will fit each individual case. The methods to pursue will depend entirely on the conditions of the water supply. Where a flowing river or creek is available so the water can be brought onto the land by gravity, one has the easiest and cheapest means for irrigation. But such ideal conditions are scarce and other means must be considered which consists in pumping. This may be done either by windmills or by power pumps, and it is good economy to install a sufficient power plant to provide water for all the necessities of the farm, including auxiliary irrigation. In localities where the winds blow with regularity the installation of a windmill is no doubt the most economical method of providing power for pumping purposes, although the wind may prove to be as unreliable as the rain and leave the farmer in a critical condition just at the time

he wants the windmill to run. Thus, taking it all around, the surest and safest way to provide for the necessary water is to install a gasoline or kerosene pump of the proper size, and pump either into a small reservoir or tank or directly into the ditch or flume to carry the water to the fields which are in need of it. Here again the special conditions of each case must be considered and the observant farmer must use good judgment in planting his fields so that the growing crops requiring most water will adjoin the pump or reservoir as close as possible so that the maximum amount of water can be given them with the least expenditure of pumping. Again, a covered tank or reservoir is much to be preferred over the open type, as the evaporation is very much less, and a concrete or a timber-lined ditch is more desirable than an ordinary ditch where the water is lost by seepage and evaporation, and also on account of the smaller grade required, reducing the height to which water has to be pumped in order to flow to the fields requiring irrigation.

The Rio Grande Controversy Adjusted.

Some years ago the American Rio Grande Land and Irrigation Co. cut a channel across a wide bend in the Rio Grande river; the consequence was that the waters of the river left the old bed and followed the new channel, leaving the land on the Mexican side of the old channel high and dry. The owners of the land have naturally objected and, being citizens of Mexico, their government has negotiated with our government in Washington until now a satisfactory and amicable solution of the problem is assured.

The terms of the settlement reached are that the Rio Grande Land and Irrigation Co. pay to the Mexican parties the sum of \$5,000 as damages, and also transfer to them the land thrown on the Mexican side by the change of the river bed. This has practically the effect of enlarging the domain of Mexico to the extent of about 400 acres, although in reality the land will still be under the sovereignty of the United States, the old river bed being the real boundary.

The Rio Grande Land and Irrigation Co. will also have to pay to the United States \$10,000 as a penalty for violation of the treaty agreement with Mexico and will pay a further penalty of \$2,000 to the United States for costs and expenses incurred in surveying and fixing the international boundary around the old dry bed of the river.

This seems to be the easiest and most satisfactory method of settlement, although it forms an awkward condition at this point by giving the United States territory of 400 acres on the other side of the Rio Grande. The channel causing this international problem was dug in 1906 by the Rio Grande Land and Irrigation Co., which owns about 50,000 acres in Texas, for the purpose of increasing the water supply for the irrigation of its land, but no sooner was the new channel cut than the increased velocity in its new bed, due to the steeper grade, cut the new channel still deeper and the waters of the river followed the new channel.

A careful study of the problem before the canal was cut might have averted this condition; with proper precaution and proper controlling works the Rio Grande Land and Irrigation Co. might have obtained the additional water desired and yet not interfere with the course of the Rio Grande.

Irrigators from Foreign Lands.

During the past month we were honored by the visits of two prominent foreign authorities on irrigation and allied branches, namely Mr. S. McIntosh, Director of Irrigation of South Australia, and Mr. V. Kadam, of Central India. Both gentlemen have made their headquarters at THE IRRIGATION AGE offices during their stay in Chicago.

Elsewhere in this issue will be found discussions by these two experts on the irrigation problems of our and their own country, with many timely and valuable suggestions.

Both of these two gentlemen traveled enormous distances and expended much time, money and trouble in order to see for themselves what is being done in the way of reclamation in this and other countries in order to compare conditions with those in their lands and, if possible, to improve the methods in vogue. Neither have they confined themselves to just taking hold of the good points they found in American practice, but they also have good-naturedly pointed out to us our shortcomings so that their visit really spells progress and advancement in our own methods of irrigation and dry farming.

One suggestion which Mr. McIntosh of Australia made is a very timely and appropriate one at this time, while the Irrigation Congress is in session, and that is the organization of an International Irrigation Congress, somewhat along the lines of the Railway Congress, which has a membership extending to all parts of the world where railroads are. His idea is to organize local bodies in the various states or provinces, with local officers; all the locals in any one country to be known as the national body of that particular country, and all the national irrigation associations to form together the International Irrigation Congress. Then the local and national bodies can hold their own meetings and discuss their own problems, independent of the International Congress; but when this latter body meets, representatives from all the local and national associations should take part in such meetings. In this way the art of irrigation and farming should be developed to its highest efficiency and all countries and nations will benefit each other by an exchange of ideas and methods.

Thoughts That Come and Go.

Don't miss the National Live Stock Show while you are attending the Irrigation Congress. It is a splendid school to attend for anyone interested in the improvement of live stock.

* * *

The ruling that a settler can rid himself of excess land he can not work or pay for is a good one and will help many a one who has bit off more than he can chew.

* * *

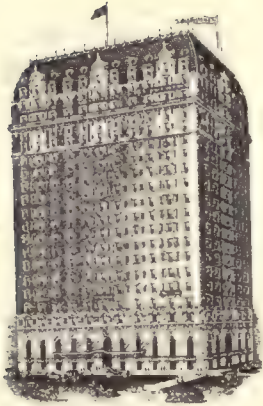
THE IRRIGATION AGE herewith extends greetings to its many friends and patrons who are doing Chicago while attending the Irrigation Congress. Chicago is a good town to visit occasionally.

* * *

The Idaho potatoes were taken up like hot cakes the other day, and something like 40,000 packages were taken from the Coliseum in one day. It shows that Idaho land is certainly making good.

* * *

Do not neglect to send in your order for the new book, "Primer of Hydraulics." It costs \$3.00, cloth bound, if order is sent with a one-year subscription.

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CHICAGO, Nov. 7th., 1911.

D. H. Anderson, Esq.,
Irrigation Age,
Chicago.

Dear Sir:

While in Chicago I desire to record my deep appreciation of your valuable and educational paper, which I have regularly received and read in South Australia, for the past five years.

Through its medium, I first became acquainted with the great firm of F. C. Austin & Company whose ad now figures so prominently on the title-page. With the consent of my Government I recently purchased machinery from this firm, exceeding in value \$25,000, and judging from the splendid results obtained I am justified in presuming that other orders will follow in the train of the first.

Wishing you every success in the good work you are doing in the joint interest of the "Irrigation Industry" and the "Man on the Land",

Very faithfully yours,

Director of Irrigation
of South Australia.

A TELL-TALE LETTER.

The above facsimile is a photographic copy of a letter received by us from Mr. S. McIntosh, Director of Irrigation for South Australia, and should need no further comment as to the value of advertising in the columns of THE IRRIGATION AGE. A correction, however, should be noted, as the F. C. Austin & Co. referred to above is now the F. C. Austin Drainage Excavator Company, Railway Exchange, Chicago, as given in this advertising, on the title page of this journal.

The Oklahoma Board of Agriculture has been asked for a permit by R. E. Jones of Mountain View, Okla., to irrigate several acres of land along the Washita River Valley. It is said that a fairly good sized reservoir will be built at the foot of Rainy Mountain and that \$10,000 will be spent in carrying out this project.

The state of Texas has recently created a state irrigation commission which shall have control of all irrigation and storage of flood water matters. One commissioner is appointed by the governor, one by the commissioner of agriculture and these two are to choose the third member. The commission is to issue permits to all persons engaged in irrigation for water storage projects or those who shall hereafter start such enterprises, upon approving their application.

Charles P. Williams, project engineer of the northern division of the United States Reclamation Service has recently visited Colorado points to secure practical irrigation farmers to teach the science to settlers under government reclamation projects. This is in line with the policy of assistance which the Reclamation Service has recently enlarged upon.

THE FORMATION OF THE SOIL*

By Alfred Vivian

One could scarcely imagine any subject for discussion more commonplace than that of the soil. Nor could one think of anything which would be less likely to prove interesting to the careless observer. We are accustomed to think of the soil as "dirt," a thing to be shunned as far as possible, and kept hidden from sight. Perhaps you will not think the soil worthy of interest and study, but did you ever stop to think that without the soil we could



Underneath all soils are found solid rocks.

not be living in this world today? The food which you eat could not be produced if there was no soil, for the plants which make the food for animals, in their turn, derive all their nourishment from the soil. So, you see, the soil is after all very important to mankind.

We are so familiar with the soil as it now exists that most of us do not stop to consider that it was ever anything different, but it has really taken a long time for Nature to form what we call the soil, and in doing so she has employed the wonderful agencies about which something will be said in this article. Some one has defined the soil as "that portion of the earth at or near the surface, which consists largely of fine particles." And again it has been described as that part of the earth into which the plants send their roots and from which they take much of their food. Well, if the soil is the portion of the earth at the surface, what is below the soil? Most of you know that if you dig down deep into the soil you will come to solid rock. Sometimes rock is reached a few inches below the surface, and again you must dig many feet before you come to it, but sooner or later you are sure to find a bed of stone. We learn therefrom this first interesting fact that underneath all soils are found solid rocks.

Now, if you were to examine a sample of soil with a strong magnifying glass or a microscope, you would find that it is largely made up of very fine particles of rock. Mixed with these particles is a much smaller quantity of black material which is called organic matter,

or sometimes humus. A little closer examination will show you that the organic matter is simply the remains of plants which have formerly grown upon the land, and which have partially decayed or rotted in the soil. Take a small quantity of black soil, heat it in the lid of a baking powder can, and see if the odor that comes off is not very much like that you notice on heating bits of leaves in the same way.

We find then that the soil is composed of small particles of rock mixed with the remains of former plants, and that by far the larger part consists of these rock particles. This suggests the thought that the soil has been formed from the solid rocks such as are found beneath it, and this, indeed, is what the men who have studied the subject have found to be true.

Geology teaches us that at one time all the surface of the earth was solid rock. At that time there was nothing like what we now know as the soil. These rocks contained all the constituents necessary to make a soil, all the substances which the plants use as food with the exception of nitrogen.

This plant food, however, was not in a form in which the plants could use it. Suppose you had a sack of wheat. You know there is plenty of food there to nourish you for some time, but it is not in a very good form to eat so long as it is in the whole wheat kernel. One of the first things you would do would be to grind it to a flour. And that is one of the first things that Nature does in preparing the food for plants; she grinds the rocks to flour. In other words, the first process in the formation of a soil is the pulverization of the rocks.

Nature uses several methods to bring about the grinding or pulverization of the rocks. The first of these is change of temperature, or heat and cold. If you examine a piece of granite, you will find that instead of being a simple rock, it is composed of different minerals cemented together. Now, these minerals are differently affected by heat and cold. You know that most substances expand when heated. The amount of expansion varies for the different minerals in the granite and as a result the effect of change in temperature is

to separate the minerals, thus breaking the rock into smaller pieces.

If you look carefully at any piece of stone you may pick up, you will find numerous cracks and openings in it. These cracks become filled with water and in the cold weather the water freezes. You know that when water turns into ice it expands with great force, and conse-



Bits of Stone Are Broken Off the Surface of the Large Rocks by Weathering

*Abstract from the Agricultural College Extension Bulletin, Columbus, Ohio, October, 1910.

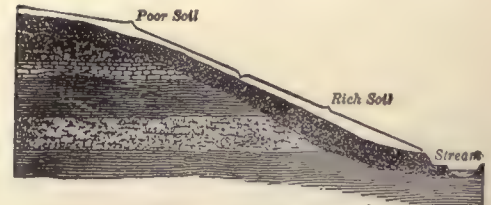
quently when the water in the cracks freezes it tends to break the stones to pieces. If you have ever known water to freeze in a bottle or jug, you know what force it exerts and from this you can see how easy it would be for the ice to break bits of stone off the surface of larger rocks.

More important than either of these factors, however, is the action of running water. You would hardly think that such a soft substance as water would do much grinding, but water running over stone grinds off the surface

make the plant food in the rocks available, but it has been found that the mineral matter alone cannot support plant life. A soil to be fertile must contain nitrogen as well. All the nitrogen in the soil came originally from the atmosphere. The air is four-fifths nitrogen, but it is in such a form that most plants cannot use it. Before it can serve as a plant food it must be combined with oxygen to make nitrate nitrogen. A little of this is formed in the air, and is carried into the soil by rain water. This amount, though very small, is probably sufficient to enable



Running Water Grinds Off the Surface of the Stones Slowly but Surely.



Showing movement of soils from higher to lower levels.



The Effect of Freezing on Rock.

slowly but surely. If the stream is swift enough to carry along particles of sand or stone, the grinding takes place more rapidly. A rapid mountain stream, for instance, tumbles the boulders along, causing them to rub against each other until they are ground to powder, and at the same time the bed of the stream itself is worn away. In this way deep valleys are sometimes worn into the surface of the earth and the fine material is carried away to form a soil at some other place.

Another agency which helps to grind the rocks is moving ice in the form of glaciers. At one time all of the northern part of our country was covered by a thick sheet of ice. This immense glacier pushed its way slowly down from Canada. As it moved south it carried with it large quantities of rocks, grinding them against each other until they were reduced to particles of various degrees of fineness. Later when the climate became warmer, the ice melted, and this rock material remained behind to become a part of our soils. So you see there are a number of ways in which the rocks are ground to smaller and smaller fragments until they become as fine as the particles in what is called soil.

But a soil produced by mere grinding of the rock alone is not suitable for the growth of farm crops. If you grind your wheat into flour you must still further prepare it before it is fit for food. In the same way the food in the rocks must be prepared for the plants. We say that the food must be made "available" to the plant, or in other words, it must be made soluble so the plants can absorb it through the roots. Water is important in bringing about this change also. Pure water will not dissolve much of the rock, but the water which falls on the soil contains carbonic acid gas taken from the atmosphere and water containing this gas will dissolve much larger quantities of the rock minerals. The oxygen of the air also helps to make the plant food available. You will see, then, that at the same time the rock is being ground its nature is being changed so that it is more readily dissolved.

These processes so far described combine to

plant growth to begin.

The first plants were undoubtedly microscopic in size and belonged to the class of bacteria or similar organisms. Even the first visible plants were of very simple forms, such as the lichens and mosses. These plants can evidently live on very small quantities of plant food, and simple as they are can take this food and build it up into organic matter which, upon the death of the plant, becomes a part of the soil. Food which has once been used by a plant is again readily made available to succeeding crops through the process of decay. In this way there is a gradual accumulation of food materials in the soil so that year by year it is able to produce an ever-increasing amount of vegetation.

The decaying organic matter produces humus and this substance in its turn becomes an important factor



The Glaciers Were Important Factors in Soil Formation.

in soil formation. The humus increases the power of the soil to retain water and to supply it to the plant, and as all the chemical changes by which plant food is made available take place more readily in the presence of sufficient moisture, it will be seen that this moisture holding power of humus is a very important factor in soil fertility. During the decay of the organic matter, carbonic acid and other acid substances are produced and these help to dissolve the mineral ingredients of the soil and change them into forms in which they can be absorbed by plants.

Gradually the lower forms of plants are replaced by



Vegetation Begins With Very Simple Forms of Plants Like Lichens and Mosses.

the higher root-bearing plants and the plant roots in their turn play a part in soil formation. The roots act both mechanically and chemically. Every one has seen examples of the enormous force exerted by plant roots in breaking apart rocks, when the plant gets started in a crevice or fissure. This same mechanical action is doubtless exerted by roots on the rocks underlying some soils. The roots also seem to secrete an acid substance which acts on the rocks with which they come in contact, and when the plants die and the roots decay they leave numerous little channels in the soil allowing the passage of air and of water laden with carbonic acid.

Sooner or later in Nature's process of soil building, plants belonging to the clover family, the so-called leguminous plants, are introduced. These plants, through the bacteria which grow in the nodules or tubercles on their roots, are able to use the free nitrogen of the air as a source of food supply. When these plants die and become incorporated with the soil the nitrogen which they have "fixed" becomes a part of the soil and is made available to succeeding plants. It has been estimated that from fifty to one hundred and fifty pounds of nitrogen per year may be fixed in this way, and this power of the leguminous plants to accumulate nitrogen is probably Nature's most important method of increasing the nitrogen content of the soil.

In addition to the processes described above should be mentioned the action of the earth worms and other forms of animal life found in the soil. These organisms are supposed by some authorities to play a very important part in the working over of the soil and its preparation for plant growth.

It will readily be understood that the various agencies concerned in the formation of the soil do not act separately nor necessarily

in any such order as that in which they have been discussed. As a matter of fact all the process described take place simultaneously. The lower plants do not wait for the rocks to be pulverized, for we see such organisms as the lichens growing on rocks from which one would think it impossible for them to obtain food. If the lichen is removed grooves or furrows will be found on the surface of the stone, due to the action of the plant.

Nor are all soils formed directly from the original rocks, for one of the effects of weather, etc., is to separate such rocks as the granites into simpler substances, with the result, for example, that huge deposits of limestone are found in one place and in another whole hills of sandstone.

The soil is almost constantly moving, for some of the same agencies which form soils are continually carrying them away. Running water grinds the rocks, but at the same time transports the fine particles to lower levels. It cuts deep valleys in the surface of the earth and carries away the debris, depositing it at various distances from its source. Notice a stream muddied by a recent rain; the mud will be deposited somewhere to help form a soil. The soil is always moving from a higher to a lower level, consequently, it is thinnest at the top of a hill and deeper in the valley. Lakes and ponds are gradually filling up and in time will become fertile fields.

From what has already been said it will be seen that the completed soil consists of rock particles, mixed with decaying vegetable matter, the remains of animals, and the various substances formed by chemical action from the rocks and organic matter. The rock particles are classified according to their size into gravel, sand, silt and clay. Gravel is subdivided into coarse and fine gravel, and at least four grades of sand are recognized, i. e., coarse, medium, fine and very fine sand. Silt is also divided by some authorities into two grades known as silt and fine silt.

The individual rock particles of a clay are the smallest recognized by the soil physicist. They are so small that they cannot be distinguished by the naked eye, nor, indeed, can they be felt between the fingers. In other words, the clay is entirely without grit and when rubbed between the fingers one can feel only the smooth mass of clay and cannot feel the individual particles. Clays are very adhesive when moist and adhere to tillage implements, and while they absorb large amounts of water, yet



Nature's Method of Increasing the Humus and Soil Fertility. Notice the Rotten Log and the Leaves Decaying, Thus Returning Plant Food to the Soil.

the individual particles lie so close together that water poured upon the surface of a clay often remains there a long time, soaking into the clay with extreme slowness.

Silt is somewhat coarser than clay; the various grades of sand being still coarser; and the gravels including the largest particles which are recognized as belonging to a true soil. The various grades of rock fragments recognized in the soil vary then from particles of about one-tenth of an inch in diameter to those so small as to be separately invisible to the naked eye.

Soils are classified in two ways, namely, as to the method of their formation, and as to their composition. According to the first classification, are recognized (1) Sedentary soils (soils in place), and (2) Transported soils.

Sedentary soils are those which have been formed just where they are found and are subdivided into a (a) Residuary, and (b) Cumulose soils.

Residuary soils have been made from the decay of the rocks on which they lie and partake more or less of the composition of the underlying rocks. They have usually lost considerable of their soluble constituents, these having been washed away by rains. These soils are not generally very deep, the underlying rock being comparatively close to the surface. Residuary soils may be fertile or not, depending on the kind of rock from which they were formed.



Running Water Cuts Deep Valleys in the Surface of the Earth and Carries Away the Debris to Form Soil at Some Other Place.

Cumulose soils are those formed in swamps and marshes. They consist largely of organic matter which has come from the partial decay of the marsh plants. They contain also the earth which has been washed down from the surrounding higher lands. Muck and peat are examples of the cumulose soils.

The principal classes of transported soils are (1) Alluvial, (2) Aeolian, and (3) Drift soils.

Alluvial soils are those which have been carried by water and deposited at some distance from their original source. They commonly show more or less distinct layers as the coarser particles are naturally the first to settle out, the finest particles being the last to be deposited. The materials found in these soils vary widely in depth, being usually shallow on high lands and deep near the mouths of the large rivers. The soils in the river valleys are alluvial and have been carried down by the stream during the flood season and deposited as the speed of the current decreased. Alluvial soils are usually fertile, but it will be seen that the character of these soils will vary with the character of the rock material of the uplands from which they are derived.

Aeolian soils are those which are composed of particles transported by the wind and are therefore sometimes called wind formed soils. These soils are also called "loess" and it is supposed that considerable areas



Nodules on Soy Bean Roots.

of soils in central United States are wind formed. They vary in thickness from a few feet to over one hundred feet and are soils of considerable agricultural value.

Drift soils are those which have been transported by glaciers. A large part of northern United States is covered by drift soil which was carried down from the north by the great glaciers which at one time covered this region. Drift soils are characterized by the presence of boulders and rounded pebbles. They are quite variable in character and many different kinds of soil may be found in a single farm located in the glaciated region. Drift soils are usually productive.

Soils are classified according to composition into clay, sand, loams, peat (or muck) and limestone soils.

A clay soil is one that contains over 60 per cent of clay particles. It is the hardest soil to work as it is sticky when wet and when dry becomes so hard that it can hardly be pulverized. In very dry weather crevices and cracks open in clay soils, letting in air and allowing the evaporation of water, which dries and injures the roots, sometimes breaking them. A clay soil unless well drained is likely to be cold and unresponsive. These soils are usually high in "potential" plant food, especially potash, but need to be carefully handled to enable the plant to make use of this food material. They are usually retentive of added plant food and are, therefore, soils which can be liberally fertilized without fear of great loss of the applied material.

Sandy soils are those containing a very large proportion of sands (75 per cent or more). They are just the opposite of clay soils, being too open and porous, while the clays are too compact and impervious. They hold but little water and crops growing on them are likely to suffer in hot, dry weather. These soils are usually low in fertility and have little power to retain added plant food as the excess of soluble material in manures and fertilizers used on them is likely to leach through them with the water. But no soil is so poor that it cannot be made to grow a crop, so even these sandy soils can be made productive by the liberal use of organic matter, and the addition, if necessary, of lime, phosphoric acid and potash. They are warm soils, work easily, and if properly handled are often profitably used for early truck crops especially.

Peat or muck soils contain very large amounts of organic matter, some of them having as much as 80 per cent of this. They are found in the beds of former lakes or swamps, and are formed by the partial decay and modification of vegetable matter under water, and usually contain but little earth. Peat is an intermediate product between vegetable matter and coal and perhaps in course of time would be converted into coal. The name muck is sometimes applied to a soil in which the organic matter is in a more advanced state of decay than in true peat.

A muck contains more earth than the peat and is less compact. These soils are high in potential nitrogen, but are usually exceedingly low in potash. When well drained and fertilized with phosphorus and potash they are generally fertile soils. Many of our black soils belong to this type.

A loam is a soil consisting of a mixture of clay, sand and organic matter and is the most desirable type of soil for most purposes. These soils are usually well balanced, as they have good power to hold moisture, are well supplied with plant food, and have considerable ability to retain such soluble plant food as may be added to them. They allow the air to circulate through them more freely than clay soils, but are not so objectionably open as are sandy soils. They are easily worked and have comparatively little tendency to bake or crust on the surface. They are well suited to most crops and respond well to fertilization. In addition to loam proper, which contains the ideal portions of clay silt, sand and organic matter, several sub-types are recognized: (1) Heavy clay loam, (2) clay loam, (3) loam, (4) sandy loam, (5) light sand loam, etc. Taken in the order in which they are stated they contain from first to last decreasing quantities of clay, and increasing quantities of sand, the heavy clay loam having the most clay and the light sandy loam



Lakes and Ponds Are Gradually Filled Up, Forming Muck and Peat Soils.

containing the most sand. These sub-types naturally partake of the characteristics of their components so that the heavy clay loam shows in a large measure the properties of a clay, and the light sandy loams are only a step removed from the sandy soils. The other sub-types are intermediate between the two extremes. The loams as a whole represent the more common types of farm soils.

Limestone soils are those formed from the decay of the underlying limestone. They are proverbially rich soils. The presence of limestone in a soil is of great importance, not merely because it is a plant food, but because of its valuable action upon and reaction with the other soil constituents. Limestone aids in the decay of vegetable matter and the formation of nitrates. It also improves the physical character of both clay and sandy soils, making them more easily controlled. Soils found overlying limestone, however, are not always high in lime, as in some cases the limestone becomes soluble and is gradually washed away. Nevertheless the soils in limestone regions generally rank high in fertility.

Soils are sometimes classified as "light" and "heavy" soils. These terms do not refer to the actual weight of the soil, but to the ease with which it may be worked with tillage implements. A sandy soil, for instance, is called a light soil, although it actually weighs more per cubic foot than any other type of soil.

RELATION OF THE LUMBER INDUSTRY TO IRRIGATION

By George M. Cornwall, Editor The Timberman,
Portland, Oregon.

The success of the lumber industry in the Pacific Northwest is linked with the splendid development of the irrigation projects in the West and Southwest. The western lumber business owes and always will owe more to the irrigation and beneficent results which flow from it than to any other single contributing factor in the development of the natural territory, in which Pacific coast lumber finds a market. A study of the great stretch of country lying east and west of the Continental Divide and south of the international boundary, embracing the great states of North Dakota, South Dakota, Nebraska, Colorado, Wyoming, Utah, Idaho, Montana, Oregon and Washington, and to the south, California, Arizona, New Mexico and Texas, makes one realize the enormous extent of the territory in which, at least in part, irrigation is and must always remain the dominant factor in its ultimate development and growth.

The passage of the bill, championed by Senator Borah of Idaho, providing for the issue of \$20,000,000 certificates to be used for the purpose of providing sufficient funds to complete the national irrigation projects, numbering in excess of twenty, now in process of completion, was an earnest attempt on the part of Congress, that it was an unbusiness-like policy to permit millions of dollars to be spent on projects and lie idle, that only required a comparatively small amount of money to complete them, in many cases, but which was unavailing on account of the plan of providing funds only from the sale of public lands within the state where the project was located. There were some exceptions to the plan outlined in the distribution of funds for irrigation projects, but in the main this policy has controlled. The lumber interests of the West and South lent their assistance to the passage of this constructive piece of legislation. They were not entirely unselfish in their advocacy of this measure.

To the lumbermen of the states of Montana, Idaho, Washington, Oregon and California, producing more than 8,000,000,000 feet of lumber in 1910, the difficulty of finding a market for their lower products of lumber has always been a problem which has mitigated against the highest development of the industry. This condition can only be overcome by enlarging the home market. Conservative lumbering is dependent entirely upon freight rates. The cost of transportation must always bear a relative significance to the value of the article to be marketed, or the traffic will not move freely. Hence, it is to be readily seen, the lumber interests of the West, if they hope to be successful, must lend every assistance to building up and creating a home market for their common grades of lumber, which approximates 80 per cent of the tree, if they can hope to make their industry remunerative.

Despite the enormity of the territory covered by the states of Colorado, Wyoming, Utah, Montana, Idaho, Washington, Oregon, California, Nevada, Arizona and New Mexico, the natural zone in which western lumbermen should find its chief distribution, nature has decreed that the thirsty and productive soil must first be watered before settlement and its consequent demand for lumber is possible, except on a very limited scale. Thus the intimate relationship between irrigation and the lumber industry of the West is easily discernible. But what particular interest does the cause of irrigation bear to the great producers of lumber lying south of the Ohio river, and why should they have lent their assistance through

their representatives in Congress to the passage of the Borah measure? Here again is where enlightened selfishness controls. The lumbermen of the West, finding a limited demand for their steadily increasing output in their natural marketing zone, invaded the yellow pine territory, lying west of the Rocky Mountains. The ox of the southern lumberman was being gored. The western lumberman had to make a price at which his product would move in competition with the southern product.

At a glance the lumbermen, even in sun-kissed Florida, realized that the only possible chance for escape from well-nigh ruinous competition from the great lumbering possibilities of the West, attracted such men as J. B. White, president of the National Conservation Congress and southern lumber operator; R. A. Long of Kansas City, also a power in southern pine interests, and other lumbermen to throw their strength in behalf of the cause of irrigation. It was self-protection. In meant a larger market for southern yellow pine, not only by possibly checking the aggressions of their western neighbors, but in Texas, Colorado, Wyoming, New Mexico and in Nebraska, where they were already doing business, and where national irrigation projects were being developed.

Today, but for the results which have accrued from the development of the West and Southwest from irrigation, the market for western lumber would have been much less than it is. Without irrigation there would scarcely be a foot of lumber sold in many valleys of Washington and Idaho except for an occasional ranchman's shanty. California alone imported from the states of Oregon and Washington by cargo 1,300,000,000 feet of lumber in 1910. The bulk of this lumber was consumed within the state, or a portion re-shipped to Nevada, Arizona and New Mexico. It is safe to say that without irrigation in the states mentioned probably less than 10 per cent of this lumber would have been consumed. This vast amount of lumber represents only a portion of the lumber consumed in the states mentioned.

Intensified farming, made possible by irrigation, is the mainstay of the western lumbermen. When the country is settled in small farms and orchards the consumption of lumber per capita is large, obviously. The reverse is true where wheat raising and stock farming predominates.

Irrigation makes possible the highest utilization of the tree, by providing a home market within zones where transportation charges are not prohibitive. It creates a steady and increasing demand for lumber, hence the lumbermen should give liberally of their substance to promote in every way possible broad and comprehensive national and state policies in dealing with either public or private irrigation. Irrigation is the handmaiden of lumbering. The irrigationist and lumberman must work together.

The National Lumber Manufacturers' Association should take a foremost place at each session of the National Irrigation Congress, especially the convention in Chicago, December 5 to 9, and lend its influence, which ramifies to every state in the Union, in behalf of the cause of irrigation, to which the lumber industry of the Northwest, in many instances, owes its very existence.

NEVADA'S IRRIGATION STATISTICS.

These are based on a preliminary comparative summary submitted by Dr. Le Grand Powers, chief statistician for the division of agriculture in the Bureau of the Census, under whose supervision it was prepared by R. P. Teele, special agent in charge of irrigation. This summary shows for both 1909 and 1899 the number of farms irrigated, the acreage irrigated, total length of ditches, the total cost of irrigation systems, and the average cost per acre irrigated. It shows for the year 1910 the acreage which existing enterprises were capable of supplying, the acreage included in existing projects, the number of independent enterprises, number of reservoirs, capacity of reservoirs, number of flowing wells, number of wells pumped for irrigation, the number of pumping plants, and engine capacity of pumping plants. The acreage irrigated is classified by the type of enterprise supplying water and by the source of water supply.

It should be noted that the figures are subject to revision, after more complete tabulation, but it is not ex-

pected that there will be any material modification of the totals or percentages reported.

The total number of farms irrigated in 1909 was 2,406, against 1,906 in 1899, an increase of 500, or 26.2 per cent. Within the same period the number of farms in the state increased 30.5 per cent. The per cent of the whole number of farms irrigated in 1909 was 89.5, and in 1899 it was 92.5.

The total acreage irrigated in 1909 was 709,018 acres, against 504,168 acres in 1899, an increase of 204,850 acres, or 40.6 per cent. The irrigated area extended more rapidly than the improved area, which increased during the 10 years by 31.8 per cent. This fact, together with the large percentage of all farms which were irrigated, shows the great extent to which agriculture in general is dependent on irrigation in Nevada.

The total acreage which all enterprises were capable of supplying with water in 1910 was 840,962 acres, an excess of 131,944 acres over the area irrigated in 1909. The acreage included in projects either completed or under construction in 1910 was 1,232,142 acres, an excess of 523,124 acres over the area irrigated in 1909. This indicates the area which will be available within the next few years for the extension of irrigation, and shows that the area irrigated can be almost doubled without the construction of additional works.

The number of independent enterprises reported in 1910 was 1,347. The total length of all ditches in 1910 was 3,106 miles, against 2,859 miles in 1899, an increase of 247 miles, or 8.6 per cent. The length of ditches reported for 1910, 1,908 miles, were in main ditches, and 1,198 in laterals. The number of reservoirs reported was 111, having a combined capacity of 325,873 acre-feet. The number of wells pumped for irrigation was 6 and the number of pumping plants 18. The engine capacity of pumping plants was 486 horsepower. The acreage irrigated with pumped water was 906 acres. The total cost of irrigation systems reported in 1910 was \$6,664,833, against \$1,533,927 in 1899, an increase of \$5,130,906, or 334.5 per cent. The average cost per acre in 1910 was \$7.93, against \$2.05 in 1899, an increase of \$5.88, or 286.8 per cent. The average cost of operation and maintenance per acre in 1909 was 90 cents, against 18 cents in 1899, an increase of 72 cents, or 400 per cent.

The acreage irrigated in 1909 has been classified according to the state and Federal laws under which the works were built or are operated, as follows: United States Reclamation Service (act of Congress, June 17, 1902), 37,185 acres, or 5.2 per cent of the total; United States Indian Service (various acts of Congress), 2,597 acres, or 0.4 per cent of the total; co-operative enterprises, 78,966 acres, or 11.1 per cent; commercial enterprises, 8,864 acres, or 1.3 per cent; and private and partnership enterprises, 581,406 acres, or 82 per cent. No irrigated acreage was reported under Carey Act or irrigation district enterprises. Works built by the United States Reclamation Service are to be turned over to the water users for operation and maintenance. Including these, 98.3 per cent of the acreage irrigated in 1909 was supplied by works controlled by the water users.

Streams supplied 668,947 acres, or 94.3 per cent of the total acreage irrigated in 1909; lakes supplied 906 acres, or 0.1 per cent; wells supplied 187 acres, or less than one-tenth of 1 per cent; springs supplied 38,840 acres, or 5.5 per cent; and reservoirs supplied 138 acres, or less than one-tenth of 1 per cent.

LOOKS ENCOURAGING FOR TEXAS.

Within the last year the following new irrigation companies (except La Ferria Mutual Canal company, which simply increased its capital stock) having an aggregate authorized capitalization of \$2,939,000, filed their charters in the Secretary of State's Department at Austin, paid franchise tax and were authorized to do business in this state:

Texaco Drilling and Irrigation Company, San Antonio, August 18; \$5,000; paid in, \$5,000; shares, 50; fifty years.

St. Stephen Land and Irrigation Company, Fort Stockton, September 10; \$250,000; paid in, \$225,000; shares, 2,500; fifty years.

A WEEDER HARROW FOR DRY FARMS*

One of the prime requirements for successful dry farming is effective tillage implements which accomplish the greatest results with the least expenditure of labor. A homemade implement (Fig. 1), which has been found very effective in dry farming in Utah, taking the place in a measure of the harrow, disk leveler, and weeder, is described by J. C. Hogenson, of the Utah Experiment Station, as follows:

"The implement consists of a rectangle, 10 by 4 feet,

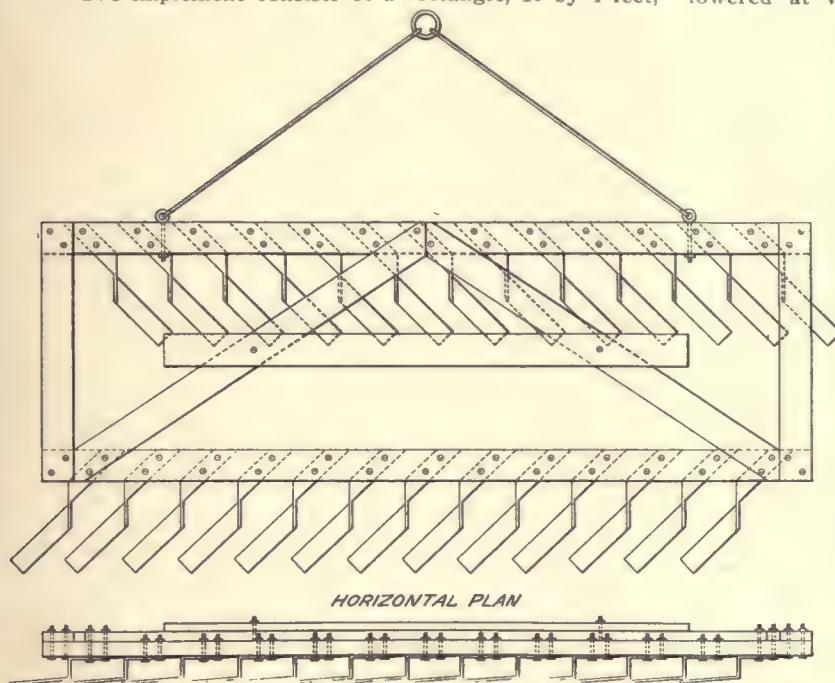


Fig. 1.—Simple Form of a Weed Harrow for Dry Farm.

made of 2-inch planks, 8 inches wide. To the under side of the 10-foot planks are bolted nine knives made from $\frac{3}{4}$ -inch steel, 24 inches long. The steel is bent 8 inches from one end so that it will drop down behind the plank. The knives are bolted to the plank diagonally at an angle of 45 degrees by means of two bolts. The bend is about 3 inches deep, which allows the knives to work that distance below the surface of the ground. The long part of the steel below the bend is sharpened on the front side so that weeds will be cut, this blade being about 13 inches long. The knives on the front slope to the right, while those on the rear plank slope to the left. This arrangement makes it impossible for any weeds to be missed, or any part of the ground to remain unstirred. The framework levels the land and crushes the clods, while the knives destroy the weeds and loosen the ground to the depth of 3 inches and form a perfect mulch."

An improved form of this implement (Fig. 2) is described by Prof. Hogenson as follows:

"The frame of the implement is made of 4-inch channel steel, 6 by 4 feet. The frame is not made solid, but the 6-foot pieces are fastened to the 4-foot pieces by means of bolts so that the 6-foot pieces can turn freely. To make the frame more solid, two iron-rod braces run diagonally from the front part of one 4-foot piece to the back part of the other. The weeder knives, 14 in number, are made of medium hardened steel, 3 inches wide by $\frac{1}{4}$ inch thick.

Each knife is 22 inches long and is fastened to the 6-foot pieces at an angle of 45 degrees by means of two bolts. Just behind the 6-foot piece a 3-inch bend is made in the knife, allowing it to drop horizontally below the frame. The front edge of the knife is sharpened. The knives on the front part of the frame, seven in number, slope to the right, while those on the rear part of the frame, seven in number, slope to the left. A lever attachment connects the two 6-foot pieces so that the knives can be raised or lowered at will. One $1\frac{1}{4}$ -inch steel axle, 6 inches in length, is bolted to the inside of each of the 4-foot pieces so that when the wheels are put on and the man is riding the machine is perfectly balanced and off the ground. Wheels are used only for transporting the implement to the field. The wheels are 18 inches in diameter with a $4\frac{1}{2}$ -inch face. The seat is placed on a bent spring on the 4-foot piece, to which the lever is attached."

Two horses can pull the implement readily. The doubletree is fastened to a ring, to which two iron rods coming from the front ends of the 4-foot pieces are attached. For summer-fallowed ground two of these implements can be run side by side, drawn by four horses, and manipulated by one man.

DUG-DRILLED WELLS VERY DANGEROUS.

Almost any community in which wells have been drilled can boast of a number of combination dug and drilled wells. The owners congratulate themselves on their wisdom in utilizing an old dug well fifteen, twenty, or thirty feet in depth, and drilling through the bottom of this to a good flow of deep water. The cost of drilling that twenty or thirty feet has been saved, certainly an economy worth considering. As a matter of fact, this combined dug and drilled well is a particularly dangerous type. It may readily breed malarial fever or even typhoid fever, which is more prevalent in the country than even in the overcrowded cities, in spite of the supposed pure water supply of nearly all farming sections. Such a well is all the more dangerous because it is fancied to be safe. Although the water encountered by

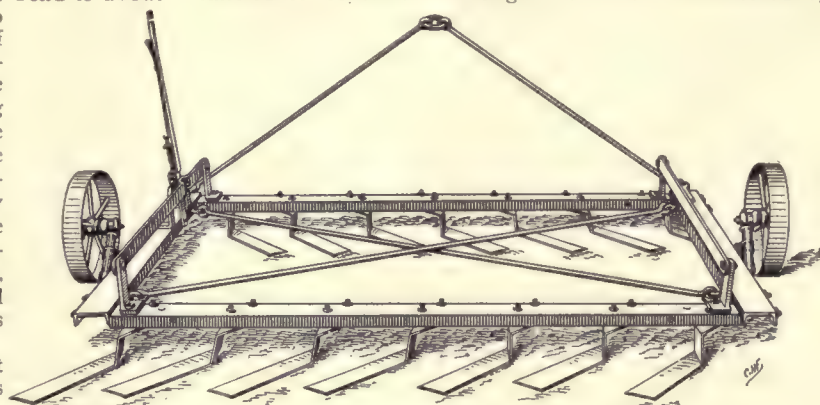


Fig. 2.—An Improved Modification of the Weed Harrow.

the deep well may be perfectly pure at the start, contamination may take place almost immediately by the entrance, especially after rains, of seeping water into the open well and thence into the casing of the drilled well. The remedies are obvious. Either the casing should be carried to the surface of the outside ground, or at least above the highest level ever reached by the water, or the open well should be converted into a water-tight system by applying a thick coating of cement over both sides and bottom.—(From Water-Supply Paper 223, United States Geological Survey.)

*Compiled from Utah Station Bulletin 112; Deseret Farmer, 6 (1910), No. 33, p. 4; Transvaal Agr. Jour., 9 (1910), No. 33, p. 78; Dry Farming, by J. A. Widtsoe (New York, 1911, p. 313).

MONTANA'S IRRIGATION STATISTICS.

This summary issued by Census Director Durand shows for both 1909 and 1899 the number of farms irrigated, the length of main ditches, the total cost of irrigation systems, and the average cost per acre irrigated. It shows also for the year 1909 acreage irrigated with pumped water and the average annual cost of maintenance and operation. It shows for 1910 the acreage which existing enterprises were capable of supplying, the acreage included in existing projects, the number of independent enterprises, the length of lateral ditches, number of reservoirs, capacity of reservoirs, number of flowing wells, number of pumping plants, and engine capacity of pumping plants. The acreage irrigated is classified by the type of enterprise supplying water and by the source of water supply.

It should be noted that figures are subject to revision after more complete tabulation, but it is not expected that there will be any material modification of the totals or percentages reported.

The total number of farms irrigated in 1909 was 8,970, against 8,043 in 1899, an increase of 927, or 11.5 per cent. Within the same period the number of farms in the state had increased 96.1 per cent, indicating that dry farming had a more rapid growth than irrigation during the 10 years.

The total acreage irrigated in 1909 was 1,679,084 acres, against 951,154 acres in 1899, an increase of 727,930 acres, or 76.5 per cent. During the same period the improved acreage on farms increased 10.6 per cent, indicating again the more rapid advance of dry farming. The area irrigated was 46.1 per cent of the improved land in farms in 1909 and 54.8 per cent in 1899.

The total acreage which all enterprises were capable of irrigating in 1910 was 2,205,155, an excess of 256,071 over the area irrigated in 1909. The acreage included in projects either completed or under construction in 1910 was 3,515,602, an excess of 1,836,518 acres over area irrigated in 1909. This indicates the area which will be available within the next few years for the extension of irrigation, and shows that the area irrigated can be more than doubled without the construction of additional works.

The number of independent enterprises reported in 1909 was 5,534. The total length of main ditches in 1909 was 12,090 miles, against 6,812 miles in 1899, an increase of 6,178 miles, or 90.7 per cent. The number of reservoirs reported was 917, having a combined capacity of 579,953 acre-feet. The number of wells pumped for irrigation was 10 and the number of pumping plants 125. The engine capacity of pumping plants was 3,057 horsepower. The acreage irrigated with pumped water was 8,023 acres.

The total cost of irrigation systems reported in 1910 was \$22,819,868, against \$4,683,073 in 1899, an increase of \$18,136,795, or 387.3 per cent. The average cost per acre in 1910 was \$10.35, against \$4.92 in 1899, an increase of \$5.43, or 110.4 per cent. The average cost of operation and maintenance per acre in 1909 was 89 cents, against 28 cents in 1899, an increase of 61 cents, or 217.9 per cent.

The acreage irrigated in 1909 has been classified according to the state and Federal laws under which the works were built or are operated as follows: United States Reclamation Service (act of Congress, June 17, 1902), 14,077 acres, or 0.84 per cent of the total; United States Indian Service (various acts of Congress), 67,417 acres, or 4 per cent of the total; Carey Act (act of Congress, Aug. 18, 1894), 9,648 acres, or 0.6 per cent of the total; irrigation districts, 4,912 acres, or 0.3 per cent; cooperative enterprises, 329,426 acres, or 19.6 per cent; commercial enterprises, 62,544 acres, or 3.7 per cent, and individual or partnership enterprises, 1,191,060 acres, or 70.9 per cent. Works built by the United States Reclamation Service are to be turned over to the water users for operation and maintenance. Including these, 92.3 per cent of the acreage irrigated in 1909 was supplied by works controlled by the water users.

Streams supply 1,632,619 acres, or 97.2 per cent of the total acreage irrigated in 1909; lakes supplied 5,622 acres, or 0.3 per cent; wells supplied 262 acres, or 0.02 per cent; springs supplied 17,967 acres, or 1.1 per cent; and reservoirs supplied 22,614 acres, or 1.3 per cent.

ALFALFA CULTURE IN AMERICA*

By Joseph E. Wing

Expert Agriculturist, Mechanicsburg, Ohio

The introduction of alfalfa into America proceeded from two sources. The English settlers in Virginia and the Atlantic colonists brought it with them, and at one time many years ago it was in repute, under the name of "lucerne," in New York, parts of New England, and Virginia. It was recognized as having remarkable value, yet as acting strangely under cultivation, responding finely for one man, refusing to grow for another; growing beautifully in one field, refusing to grow in an adjacent one. It failed to make much seed, and eventually its culture died out almost entirely in the Atlantic region.

The Spanish people brought alfalfa to Chili, Mexico, Peru, and in a small way to southern California. It thrived in the dry, warm valleys, in soils rich in mineral elements and well watered by irrigation. Its influence was unfelt in the United States until the settlement of California. The earlier settler sought only gold, but soon there appeared another class who sought by tillage of the soil to gain wealth by feeding the gold hunters. Thus there grew up a sort of pioneer farming in California.

From California the plant spread eastward to Utah, to Colorado, to Idaho and Montana, to Kansas, Nebraska, and, later, to Ohio, Illinois, Indiana, Wisconsin, and New York; and now in these blessed days of prosperity it has gone to nearly every state in the Union, is grown in Alberta, Canada, and many of the islands of the sea.

And yet, with all its spread, alfalfa growing has only just begun in the eastern states. One farmer in ten in favored regions is growing it, and he is growing only half or maybe a tenth of what he will some day. The other nine farmers will learn—they must—or else be crowded out by their more favored competitors. It was held for a long time that alfalfa growing must be confined to certain climatic belts. Now it is known that it thrives, so far as climate is concerned, almost equally well from the Atlantic to the Pacific, from the Lakes to the Gulf. Certainly, it gives more crops in warm climates where it has a longer growing season, but any part of America, saving the high mountain plateaus, is warm enough for two crops a year.

Much needless mystery has been made of the alfalfa seeding question. So much mystery, in fact, that many farmers are afraid to try it at all. Jones recommends one method and Smith another; and how is the farmer to tell which is right? We began the study of the alfalfa question twenty-five years ago, and since that time we have carefully watched fields of it in almost every state in the Union. We have corresponded with thousands of successful growers, and with thousands of other growers who were having troubles, and we really believe now that we are able to furnish reliable data as to just what it is necessary to do in order to succeed with this plant.

We could almost sum the matter up in four words: Lime, drainage, humus, and inoculation. Perhaps we have given these in order of their relative importance. Lime is necessary on soils not naturally of limestone formation or filled with limestone pebbles. The importance of this is impressed upon us more and more each year; in fact, we believe today, that there have been more failures throughout the United States on account of insufficient lime in the soil than from any other cause.

Then as to drainage; there is no use in planting alfalfa on any soil where water may ordinarily be found at a depth of less than three feet. The alfalfa may grow all right until its roots strike this water, but then it will probably die.

Fertile soil contains enough humus. Impoverished soils may be so deficient that special preparation must be made before alfalfa can possibly succeed. Stable manure, where obtainable, is the very best thing for adding the proper humus to the soil; and we would urge its

*Abstract of the I. H. C. Service Bulletin "For Better Crops."

liberal use wherever possible. It might be best to use this a year in advance of sowing alfalfa, and follow with clean cultivation to overcome what weeds might be sown with the manure, or, a good way is to top dress the alfalfa during its first winter, using a manure spreader and applying the manure evenly without large chunks that might smother the young plants. On impoverished soils, we would recommend preparation for alfalfa one or two years in advance, growing such crops as crimson clover, mammoth clover, cow peas, Canada field peas, or soja beans, and preferably turning them under or else pasturing them off, so as to give the soil the greatest benefit possible from them.

We recommend inoculation, not that it is always necessary, but it is an inexpensive process, and in five cases out of six it will actually pay.

Having determined that our soil is sweet, well drained, and sufficiently supplied with humus, the only questions that remain are: The preparation of a good seed-bed; sowing at the proper time of year; and, the use of good seed. For the seed-bed, it is essential that the ground be carefully fitted. It must be plowed, unless it is old ground, such as corn stubble, which may be thoroughly disked instead of plowing. It is better to firm the subsoil a little, so that only the surface is really loose. This, because if the entire soil is very loose, the seed may be planted too deep, and also because the alfalfa seems to prefer the subsurface being a trifle firmed.

On Woodland Farm, for many years it has been our custom to sow alfalfa at oat-seeding time, about the first week in April, using beardless spring barley as a nurse crop. The barley is usually cut for hay the last of June, and after this we sometimes secure a good cutting of alfalfa hay the first season, although we do not count on this, and are not disappointed if we do not obtain it. We sow about three to five pecks barley to the acre—on real rich ground not more than one bushel—and eighteen to twenty pounds of alfalfa seed at the same time, usually using a disk drill and throwing the alfalfa seed in front of the drill, unless the ground is very loose, in which case we throw the seed farther back to prevent its being covered too deeply. The alfalfa seed should be covered about an inch. The advantages of this system are that the rains usually come about the right time for the young alfalfa, which makes a strong growth throughout the entire season, generally giving us with the barley enough hay the first year to pay the expenses of planting, and goes into winter into vigorous shape with about ten inches or a foot of stalk standing, enough to hold the snow

throughout the winter and induce a fine, vigorous start in the spring. We find barley to be the best nurse crop obtainable. It takes the place of the weeds that would otherwise come, gives us some very excellent feed, and with us, does the alfalfa good and no injury. Oats are not so good, because they shade the ground more and are much more inclined to lodge. We find that the barley hay with the small amount of alfalfa we obtain with it makes a forage second only to the pure alfalfa itself. We cut this when the barley is in the milk or dough stage. It is not always necessary to cut the barley for hay, as it ripens its grain about July 12th in this latitude, and it is rarely that alfalfa is suffering much by that time. Many of our neighbors cut their barley for grain, and still secure admirable stands of alfalfa. Where no nurse crop is used, it is seldom safe to plant alfalfa before the 20th of June, because the weeds will almost certainly choke the young plants, and no amount of mowing will prevent their doing so.

For summer seeding we recommend as a good method, having the alfalfa follow a crop of early potatoes, or it may be possible to plow wheat stubble early enough to secure a stand before winter. An excellent way is to plow the ground early in the spring, harrow it as frequently as the weeds appear, and sow the alfalfa during July. If the rains come right, such alfalfa should make excellent growth before winter and be certain to succeed. We really believe that where beardless spring barley may be used as a nurse crop, the early spring seeding is advisable in the states of Ohio, Indiana, Illinois, Michigan, New York, and much of Pennsylvania. The late seeding is certainly preferable in some of the New England states, in Virginia, and the states south of the Ohio river. The reason for the late seeding in these states is that their climate seems to be such that the alfalfa thrives better when sown late than when sown early, and also in part of these places quack or crab grass and other weeds will give so much trouble that the early seeding is almost sure to fail on account of them. The farther south one goes, the later is it safe to seed alfalfa. We have many customers in Georgia, Alabama, Mississippi, Louisiana, and Texas, who seed as late as November 1st, but their winters are so mild that the alfalfa never winter-kills, and it comes on the next spring in just as good shape as if it had been sown earlier in the season.

We find that on nearly all soils, phosphate does alfalfa more good than any other fertilizer. We recommend basic slag on soils that are acid and where you do not wish to sow lime, or untreated phosphate rock on



An Alfalfa Field in Bloom.

limestone soils that are not acid. For the quickest and best results on these limestone soils, use one hundred pounds acid phosphate and nine hundred pounds untreated phosphate rock per acre. The untreated phosphate will absorb acid from the acid phosphate, and the combination will bring the quickest results of any form of phosphate which can be applied. Also, applied in this way, the superfluous acidity being taken up by the raw phosphate, there will be no danger of making your land sour. Good barnyard manure as a fertilizer for alfalfa cannot be beaten; it should, however, go hand in hand with the phosphate; neither is complete without the other. They should be applied at the same time for best results.

Good seed is of great importance. Alfalfa seed coming from Arizona, South America, or Arabia, will grow all right the first year, and then will probably winter-kill the first winter, especially in any of the northern states. We find that the very best seed in the world, that which is freest from dangerous weeds and which possesses the greatest vitality, is produced in our own United States, particularly in the northwestern part. Also it is better if grown on non-irrigated soil.

In some of the far southern states, an enemy constantly to be fought is the Johnson grass. In some of these states alfalfa seed is produced, and is very likely to be mixed with this pest.

The poultryman will find great profit from having a run of alfalfa. This should not be too small a space, but large enough so that the poultry can forage at will without injuring the plants, and so that he may cut the hay regularly and save it for winter feeding. Poultry thrive upon a diet composed chiefly of alfalfa, with some grain in addition.

No other food forms so good a basis for the ration of a dairy cow as alfalfa, the reason being its extreme richness in protein, and its easy digestibility, and the additional reason that the cows love it so, and eat it so greedily. Alfalfa growing countries have a great advantage over other countries in the dairy business, so that it is well for the dairyman, wherever he is situated, to begin to consider how he may make his own soil an alfalfa-growing soil. It has been found that the cost of milk production can be cut square in two by the use of home-grown alfalfa. A ton of alfalfa hay, early cut and nicely cured, as food for the dairy cow is worth as much, pound for pound, as the best wheat bran. In order to get its full feeding value, it should be ground. Even ordinary alfalfa hay is worth nearly as much as wheat bran; so that it is clear to the eastern dairyman, who must pay \$25.00 a ton for wheat bran, a field of alfalfa yielding no more than three or four tons per acre is a veritable gold mine. Governor Hoard has found that with alfalfa in the dairy ration, it is necessary to use only about half the amount of grain that must be fed when other forage is provided. In truth, with alfalfa hay and corn silage, little or no feed is needed to keep the dairy cow in the most profitable producing condition. We thus emphasize the importance of alfalfa to the dairyman, because among the many thousands of eastern dairymen, the margin between cost of production and selling price of their products is so small that they are in a rather discouraged condition, and this condition, alfalfa will relieve better and more easily than any other thing. There was a time, only a few years ago, when it would have seemed not worth while thus to attempt to raise the hopes of the dairyman, for then it had not been demonstrated that alfalfa could be grown away from the "alfalfa belt." But since then we have learned the few simple requirements of the alfalfa plant, and we do not hesitate to affirm that we can grow alfalfa anywhere, upon any farm in the United States not at too high an altitude, if the few simple but essential conditions are complied with.

We usually cut it when about one-fifth of the plants begin to show bloom. A somewhat better way of ascertaining the proper time is to watch for the buds at the base of the plants and cut when they appear above the ground. These buds are the beginning of new stalks, and their appearance indicates that the plant is ready to make another crop.

It is especially adapted to being de-pastured by horses and hogs, and perhaps the greatest profit comes from such use. The practical difficulty with de-pasturing alfalfa with sheep and cows is that, being a clover, it sometimes causes bloat, similar to clover bloat. The best preventive of bloat is to have the alfalfa mixed with grasses in the pasture. When this is done, the animals eating the two together are very much less apt to bloat. The best grass to mix with alfalfa for pasture is brome grass (*bromus inermis*).

In pasturing alfalfa, to get the best results, one should not turn stock on it before the plants have grown nearly to the blossoming stage; furthermore, the pasture should be so large that the animals will not eat it down close. It should be mown at least twice during the season and made into hay. It will not do, however, to pasture the field with sheep or cattle immediately after it has been mown, this being the surest known method of inviting disaster. After alfalfa is mown, it is not safe to turn stock onto it until the plants have reached the woody stage. Thus treated, alfalfa pastures will last for years, and afford an astonishing amount of nourishment.

All stock should be taken off of alfalfa pastures by the first of October, or, in the eastern states, at the be-



A Heavy Crop of Alfalfa.

ginning of hard frosts; this, both for the good of the alfalfa and for the good of the animals themselves. It is dangerous to de-pasture frozen alfalfa, and it is not even wise to cut it for hay. A profitable scheme sometimes practiced, is to break an old blue grass pasture, plow it rather deep, fertilize it well, and seed it down to alfalfa. A good stand of alfalfa is almost assured by this method, while the blue grass comes up immediately and fills in between the alfalfa plants; within a few years, the amount of combined herbage yielded by this practice is almost incredibly great, the grass itself yielding more than it did before the alfalfa was sown upon it. Alfalfa thus sown will not last as long as when the grass is absent, but while it is there, it is extremely profitable.

In any of the states east of the Missouri, we think that farmers who pasture alfalfa with cattle and sheep may be reasonably sure to have some losses, no matter how careful they are. We have never succeeded in pasturing it ourselves without some losses, but we believe it is sometimes more profitable to pasture alfalfa and lose a few sheep or perhaps a steer, than it is to handle our stock on other feed without this loss.

All legumes have tiny bacteria that work on their roots, forming "nodules." These bacteria draw nitrogen from the air, and both supply the plants with it and also add it directly to the soil. Without these bacteria the legumes will soon perish, although most of the legumes seem to find their proper bacteria in almost any soil.

(Continued on page 71.)

THE PRIMER OF HYDRAULICS*

By FREDERICK A. SMITH, C. E.

5. The Chicago Drainage Canal.

This canal connects Lake Michigan with the Mississippi river via the Chicago, Desplaines and Illinois rivers, and is a splendid example of a successful solution of a great sanitary and engineering problem, providing at once means for diverting Chicago's great Sewer, the Chicago river, from the same city's great reservoir of drinking water, Lake Michigan, and at the same time introducing sufficient dilution to prevent evil effects in its course to the people in the Illinois and Mississippi river valleys; this on the one hand prevents further pollution of Chicago's water supply and also forms the first and most costly link in a deep water way from the Great Lakes to the Gulf.

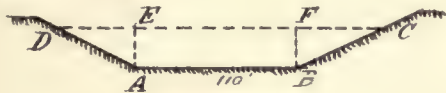


Fig. 84.

The canal proper starts at Robey street, Chicago, and extends to Summit, Ill., a distance of 7.8 miles, having a cross section shown in Fig. 84, 110 ft. wide at the bottom, and side slopes 2 to 1; the elevation of the bottom at this point is -24.448 (which means 24.448 feet below lake level). From Summit to Willow Springs, a distance of 5.3 miles, the cross section is indicated in Fig. 85, being 202 ft. wide on the bottom with side slopes 2 to 1. From Willow Springs to Lockport, 14.95 miles, the channel is cut in rock, with a width on the bottom of 160 feet, with sides nearly perpendicular (162 wide 22 ft. above bottom). This section is shown in Fig. 86. The grade through the earth section is 1 in 40,000 ft., or $s = .000025$; in rock the grade is 1 in 20,000, or $s = .00005$.

At Lockport, where the waters of Lake Michigan join those of the Desplaines river, ample controlling works have been erected to regulate the flow to necessary requirements. While at present the flow is about 400,000 cub. ft. per min., it is expected that this will be gradually increased so that when the population of Chicago becomes 3,000,000, the flow of lake water will reach 600,000 cub. ft. per min., or 10,000 cub. ft. per second. Before this latter volume is sent down the canal the earth portion from Robey street to Summit

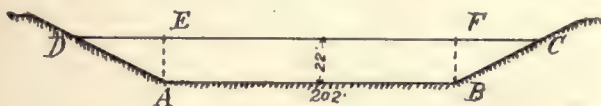


Fig. 85.

will have to be widened out to 202 ft. on the bottom, conforming to section shown in Fig. 85. The Chicago river connects the canal with Lake Michigan and has a length of 6 miles from Robey street to Lake street. Its width was quite variable at the time the drainage canal was constructed, but has been improved, and has now almost a uniform width

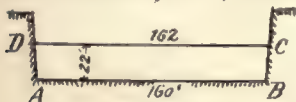


Fig. 86.

of 200 feet, a depth of 26 ft. for 100 feet in midchannel, and 16 feet on the dock lines, as shown in Fig. 87.

We can now consider several of the problems which present themselves in connection with the drainage canal.

6. Problem.

A flow of 300,000 cub. ft. per minute stands 22 ft. deep in the narrow channel shown in Fig. 84. What is the coefficient of roughness n ?

The cross sectional area of flow is easily computed and is 3,388 sq. ft.; the flow is 5,000 cubic ft. per second, hence the mean velocity $v = 5,000 \div 3,388 = 1.48$ ft. per second.

The hydraulic radius is next computed:

$$r = \text{area } DABC \div DA + AB + BC.$$

$$r = 3,388 \div (49.19 + 110 + 49.19).$$

$$r = 3,388 \div 208.38 = 16.26.$$

$$\text{Then } \sqrt{r} = 4.032.$$

$$\text{The slope } s = .000025 \text{ and } \sqrt{.000025} = .005.$$

The data on hand will give now the factor C since $C = v \div \sqrt{rs}$, hence:

$$C = 1.48 \div 4.032 \times .005.$$

$$C = 1.48 \div .02016 = 73.41.$$

Consult table No. 12, ($n = .040$) and we find opposite 4.0 in slope column .000025 the factor C 78.45. Next consult table No. XIII ($n = .050$), we find opposite 4.0 in slope column .000025 the factor $C = 65.02$, hence the value of n in this case is greater than .040, and less than .050; by interpolation we find the difference is 13.43, that is, the factor C decreases 13.43 while the factor n increases from .040 to .050, or at the rate of 1.343 for each .001; the factor C in question equals 73.41, or 5.04 smaller than the C belonging to .040; hence as often as 1.343 is contained in 5.04, that many times will .001 have to be added to .040 for the required factor n ; this gives 3.7, or (nearest) 4 times .001 added to .040 gives .044 as factor n for this section.

7. Problem. Find the slope s .

As this volume of the water strikes the earth channel between Summit and Willow Springs where the cross section is considerably larger, it stands to reason that, all other things being equal, there will be a reduction in the slope s , on account of the reduced velocity. The area in Fig. 85 equals 5,412 sq. ft., and the wetted perimeter equals 300.38 ft., hence:

$$r = 5,412 \div 300.38 = 18.017.$$

$$\text{Then } \sqrt{r} = 4.25.$$

$$\text{The velocity } v = 5,000 \div 5,412 = .924 \text{ ft.}$$

From $v = C \sqrt{rs}$ we have by transposition:

$s = v^2 \div C^2 r$, in which equation v and r are known. To find C we assume that the factor n is the same as in the preceding case, namely, .044, and again find C by interpolation, as follows: If n were = .040, C is found from table No. XII (last column), between $\sqrt{r} = 4.0$ and 5.0; C for 4.0 = 78.45; for 5.0 = 89.28; difference = 10.83; hence difference for .25 = 2.71; add this to 78.45 gives 81.16 as C for $n = .040$; proceed likewise for factor C if $n = .050$, which produces 2.45 to be added to 65.02 = 67.47. Now we have C for .040 = 81.16 and C for .050 = 67.47; hence difference 13.69 or 1.37 for .001; multiply by 4 gives 5.48 to be subtracted from 81.16 (because C diminishes as n increases) gives 75.68 as factor in C for the case under consideration.

If we substitute now the known values in:

$$s = v^2 \div C^2 r, \text{ we obtain:}$$

$$s = .924^2 \div 75.68^2 \times 18.017.$$

$$s = .000008.$$

8. Problem.

We will next consider the flow of 5,000 cub. ft. of water through the rock section shown in Fig. 86. The cross section of the flow equals 3,542 sq. ft. and the velocity 1.41. As this section eventually will have to accommodate a flow of 10,000 cub. ft. per second, the slope of the flow in this case will be only half the final slope of .00005, or $s = .000025$, and we can now determine the factor n for the rock cut.

$$\text{Area of flow} = 3,542 \text{ sq. ft.}$$

$$\text{Wetted perimeter} = 160 + 22.02 + 22.02 = 204.04.$$

$$r = 3,542 \div 204.04 = 17.3596.$$

$$\sqrt{r} = 4.167.$$

The factor C can now be determined since

$$C = v \div \sqrt{rs}, \text{ namely:}$$

$$C = 1.41 \div 4.167 \times .005 = 67.1.$$

To find coefficient of roughness n proceed as follows:

In table No. XII (where $n = .040$), opposite $\sqrt{r} = 4$, we find under $s = .000025$, $C = 78.45$. In table No. XIII, where $n = .050$, we find 65.02, and since our factor $C = 67.1$ lies between the two, it follows that coefficient n is greater than .040 and smaller than .050, and found exactly by interpolation, as explained above; this brings $n = .048$.

Right here it may be said that these values of n are taken entirely too high; the designers of the drainage canal evidently desired to be on the safe side when they computed cross sections and slopes, for it stands to reason that a channel of such regular section should have a much lower factor of roughness than what is indicated above; they should not

be much more than .025. However, it is well that the capacity is above present requirements; there are splendid controlling works at Lockport which regulate the flow precisely to what is wanted by increasing or decreasing the slope of the flow.

The applications shown above relate merely to the principles involved; as a matter of fact the slopes in use are much smaller than what is indicated and they are determined by the controlling works at Lockport.

9. The Chicago River.

The foregoing subject is closely related to the Chicago river, which will be discussed in this paragraph from the hydraulic point of view. The topography of the water shed of the Chicago river near Lake Michigan has a very gentle slope toward that body of water, and the different branches of the river are therefore particularly adapted for harbor purposes. Before the completion of the main drainage canal, when the sewage of Chicago was pumped from the Chicago river into the Illinois and Michigan canal, it was a common occurrence to notice the river flow first toward the lake and then toward the canal; the former occurred after heavy rain storms when the pumps at Bridgeport were unable to cope with the flood. At such times and during protracted floods the black waters of the river would enter the lake and often reach the intake cribs of the Chicago water supply, contaminating same. The completion of the sanitary canal gave Chicago permanent relief from this, and gave a positive outlet to the Chicago river into the drainage basin of the Desplaines river.

The Chicago river within the limits of Chicago is principally used as a harbor and for navigation; this implies that the velocity of the current should be low at all times to prevent accident to shipping. For this reason the cross section of the river is made ample.

Figure 88 shows an older typical section of the Chicago river, having a width of 200 ft.

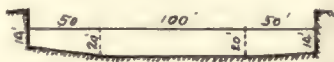


Fig. 88.

and a depth varying from 14 ft. at the dock lines to 20 ft in midriver. The effective flow area is composed of $16 \times 50 = 850 + 100 \times 20 = 2,000 + 16 \times 50 = 850 = 3,700$ sq. ft.; the wetted perimeter equals: $14 + 50.36 + 100 + 50.36 + 14 = 228.72$, hence the hydraulic radius equals:

$$3,700 \div 228.72 = 16.18, \text{ hence:}$$

$$\sqrt{16.18} = 4.02.$$

GOOD NEWS FOR THE SETTLERS.

Under the ruling of the secretary of the interior no steps will be taken until March 15 to enforce forfeiture for failure to make payment entries and water right applications on reclamations which become due December 1, 1911.

This extension of time is applicable to cases in which the orders issued in pursuance to the act of February 5, 1911, merely postponed action regarding delinquent payment to December 1, 1911, as in the cases of the Shoshone, Wyo., project. For this project no action will be taken upon delinquencies occurring March 1 and December 1, 1911, until after March 15, 1912, at which time both installments must be paid.

For the North Platte, Wyoming-Nebraska and Carlsbad, N. M., projects, public notices are being prepared providing for graduated payments and extension of time, and pending their issuance no action looking to cancellation on account of non-payment will be taken until after March 15, 1912.

In its publication of the results of studies of the water resources of the country the United States Geo may be successfully closed by using small burlap sacks filled with earth and laid in such a manner as to stop the flow of the water. If there is not too much water flowing, the break may be stopped, it not being necessary to turn the water out of the lateral for repairs.—R. L. Parshall, Colorado Agricultural College, Fort Collins.

DO IT NOW.

Remit \$2.50 for the "Primer of Hydraulics," cloth bound; it will be ready in January, 1912.

CORRESPONDENCE

SOME VALUABLE SUGGESTIONS.

Chicago, November 6, 1911.

D. H. Anderson, Esq.,
IRRIGATION AGE,
Chicago, Ill.

Dear Sir:—I take this opportunity of tendering you my very best thanks for the very kind interest you have displayed toward a "wandering cousin" from the "Land of the Southern Cross." My trip to Chicago, although rather a hurried one, has been most interesting and instructive. The city is really a most marvelous one when its age is considered. This wonderful growth is, as far as I can gather, due to three causes. *One*, its splendid geographical position. *Two*, the great natural resources of the surrounding country, and, *three*, the colossal spirit of enterprise on the part of its inhabitants, who apparently are striving for all they are worth to make it truly one of the very first cities of the world. May their laudable object, at no far distant date, be attained.

When I left Australia in April last I expected to have had the pleasure of attending the Nineteenth Irrigation Congress, which I understood from Mr. Elwood Mead, of Victoria, would take place about September last. Naturally I was much disappointed when I became apprised of the fact that it had been deferred until December. From what I can gather, the country around Chicago will then be clothed in true winter garb. As a result there will be but little or nothing to interest one in the matter of crops, irrigation or drainage.

As my trip abroad has already been prolonged beyond the original intentions, I have decided not to await the congress in question, much as I would like to do so.

I had the pleasure of attending the Dry Farming Congress at Colorado Springs last month, when I much appreciated meeting quite a number of the leading agriculturists of your great country, in addition to the international fellow delegates.

While on the subject I would like to record my views briefly on this great "agricultural movement" as a most powerful factor in promoting the welfare of the producers of the world at large and the peace of the latter which is desired by the majority of mankind. To secure the finest results a reorganization of the Dry Farming International Congress is, in my opinion, an imperative necessity.

First, I would suggest the formation of district circles for the purpose of keeping the local producers closely in touch with each other on all matters connected with dry farming, irrigation, and all general principles likely to promote the common welfare of the farmers, both "wet" and "dry."

Second, the holding of a state convention once a year at which delegates from all district circles could attend and mutually assist each other and the state by discussing matter of general interest and deciding upon the best general method of cultivation, etc.

Third, the holding of an annual national convention once a year in different states in turn. Here all national questions could be dealt with likely to benefit the producers at large within the confines of the Union.

Fourth, provision for the international congress to be held in the various great centers of agricultural activity of the world in rotation. Here all questions of general principles, as far as could be made adoptable to the different varying climatic conditions, might be discussed, and decided upon.

The opportunities afforded the delegates from the respective countries in meeting with each other and discussing matters of general interest to the producer, in addition to the privileges of their personally inspecting the different systems and methods of cultivation, etc., in actual operation would, I feel assured, result in an all-around improvement in the economic agricultural principles and practices of the world at large.

Such an organization as far as applicable to be adopted by all countries directly interested.

Should I have attended the Irrigation Congress in December it was my intention to have brought the subject as outlined before the conference for consideration.

Regarding the "Dry Farming Convention," a promise was made by the Canadian delegates at the recent meeting to the effect that an attempt would be made to reorganize its constitution at the Lethbridge, Alberta, gathering next year.

Again thanking you for your kindness, with best wishes,
Very faithfully yours,

(Signed) S. McIntosh.

IRRIGATION BY PUMPING FROM WELLS

Editor IRRIGATION AGE:

The experience in the Garden City, Kan., district now is not unlike that in an oil or gas district in regard to "bringing in" a well.

Development of the pumping for irrigation industry in the Garden City district has progressed amazingly in the last six months and work will continue during the period of the fall and winter and to a great extent when spring shall come.

It is likely that no such activity is seen anywhere in the West today. Two large contracting outfits and manufacturers of special well casings and well equipment are now at work within a radius of 50 miles from Garden City in the Arkansas Valley, close to the Colorado line, and a new well is brought in every few days. These wells vary from 1,000 to 2,500 gallons per minute, depending on the motive power used. The water appears to be inexhaustible. To show what a volume of water this is, a well producing 1,000 gallons per minute will run 60,000 gallons per hour, or practically $1\frac{1}{2}$ million gallons per 24-hour period. The average town of 5,000 population will not consume so much water as that for all of its municipal purposes.

This apparently inexhaustible supply of water lies from 10 to 100 feet below the surface throughout the Arkansas Valley in Kansas and wells are sunk from 40 to 200 feet without the depth or the lift being prohibitive. The water lies in sand or water-bearing gravel and its quality for irrigation purposes of course exceeds very greatly the muddy water with various deposits coming from the river through the ditches.

A well may cost from \$250 to \$500 complete, depending on the depth and on the flow or the expensiveness of the motive power finally used. Oil, distillate, gasoline and electricity are used. A well flowing 1,000 gallons per minute will come pretty close to taking care of a quarter section of land. This makes it the cheapest water-right on earth.

This wholesale bringing in of wells for irrigation is rapidly transferring the Garden City district into an extensive farming area where the principal products are beets, alfalfa, fruit, melons and garden truck. The Garden City district abounds in all these and special attention has been given recently to celery and sweet potatoes.

R. H. Faxon.

WANTS INFORMATION ON ALFALFA SEED.

THE IRRIGATION AGE,
Chicago, Ill.

Weiser, Idaho, November 13, 1911.

Dear Sir:—Can you advise me as to where I can get some literature on "Raising Alfalfa for Seed?" Or on irrigation in the Northwest?

Yours very truly,

R. E. Betzer,

Box 634, Weiser, Idaho.

[There appears in this issue a lengthy article under the headline: Alfalfa Culture in America, which contains much useful and instructive matter in regard to the above subject. There will be another illustrated article on alfalfa in the January issue of our journal. It is a very important subject to our readers and any practical points will be appreciated.—EDITOR.]

THIS SAVES YOU FIFTY CENTS.

Remit \$3.00 for one year's subscription to THE IRRIGATION AGE and one copy of the "Primer of Hydraulics," cloth bound.

NORTH DAKOTA'S IRRIGATION STATISTICS.

Census Director Durand has issued the first official statement from the Census Bureau relative to the statistics of irrigation in the state of North Dakota.

It is based on a preliminary comparative summary submitted by Dr. Le Grand Powers, chief statistician of the division of agriculture in the Bureau of the Census, under whose supervision it was prepared by R. P. Teele, special agent in charge of irrigation. This summary shows for both 1909 and 1899 the number of farms irrigated, the acreage irrigated, the number of independent enterprises, the length of main ditches, the total cost of irrigation systems, the average cost per acre irrigated, and the average annual cost of maintenance and operation. It shows also, for the year 1909, the acreage which existing enterprises are capable of supplying, the acreage included in existing projects, length of lateral ditches, number of pumping plants, engine capacity of pumping plants, and acreage irrigated with pumped water. The acreage irrigated is classified by the type of enterprise supplying water and by the source of water supply.

The act of Congress of February 25, 1910, under which the census of irrigation is being taken, provides for collecting full information concerning the location, character, and cost of irrigation enterprises; whether such enterprises are conducted under national, state, or private control; the acreage of land irrigated; the prices at which land with water rights can be obtained; and the quantity of water used for irrigation.

It should be noted that the figures are subject to revision after more complete tabulation, but it is not expected that there will be any material modification of the totals or percentages reported.

The total number of farms irrigated in 1909 was 69, against 54 in 1899, an increase of 15, or 27.8 per cent.

The total acreage irrigated in 1909 was 10,248 acres, against 4,872 acres in 1899, an increase of 110.3 per cent. During the same period the improved land in farms increased 112.1 per cent, showing that irrigation development was at about the same rate as agricultural development generally. The per cent of the improved area irrigated was 0.05 in both 1899 and 1909, indicating the unimportant place which irrigation occupies in the agriculture of the state.

The total area which all enterprises were capable of supplying with water in 1910 was 20,687 acres, an excess of 10,439 acres over the area irrigated in 1909. The total area reported as included in projects in 1910 was 36,943 acres, an excess of 26,695 acres over the area irrigated in 1909. This indicates in a general way the area of irrigated land which will be available for settlement within the next few years.

In 1910 the number of independent enterprises was 49; the total length of ditches was 123 miles; and there were 22 reservoirs, having a capacity of 132,187 acre-feet. Most of this reservoir capacity, however, is in a natural lake from which only a small volume of water is taken for irrigation.

The total cost of irrigation systems to July 1, 1910, is reported as \$789,533, as against \$16,980 in 1899, an increase of \$772,553 or 4,549.8 per cent. The average cost of irrigation systems per acre to which these systems were ready to supply water in 1910, was \$38.17, against a cost of \$3.49 in 1899, an increase of \$34.68 per acre, or 993.7 per cent.

The average annual cost per acre for maintenance and operation in 1909 was \$3.78 per acre.

Of the acreage irrigated in 1909, 1,610 acres, or 15.7 per cent, was supplied by works built by the United States Reclamation Service. The remaining 8,638 acres, or 84.3 per cent, was supplied by individual and partnership works. Under the law the works built by the United States Reclamation Service are to be turned over to the water users for operation and maintenance, and when this takes place all the land irrigated in North Dakota will be served by works controlled by the water users.

Streams supplied 8,787 acres, or 85.7 per cent of the total acreage irrigated in 1909; springs supplied 200 acres, or 2 per cent; reservoirs supplied 1,260 acres, or 12.3 per cent.

Supreme Court Decisions

Irrigation Cases

PERCOLATING WATERS—

The findings in a suit to enjoin defendant from pumping water from its wells on its lands adjacent to plaintiff's lands for irrigation of remote lands, that underlying the lands in controversy, including the lands of plaintiff and extending to the foot of the mountains, are water-bearing strata, that an almost impervious dike which extends across the tract arrests the progress of the water underlying plaintiff's land, that the subterranean waters are supplied by rains falling on the mountains, and find their way into the water-bearing strata and percolate through the same, that the waters in the water-bearing strata underlying the lands of plaintiff and other lands in the vicinity, including the lands in which defendant's pump is situated, are, in their natural state, under pressure from the head of the waters near the mountains, etc., show a common supply of percolating waters lying in continuous strata saturated with water and extending under the lands of the parties, and justify relief to plaintiff.—*Burr v. MacLay Rancho Water Co. (Hill, Intervener)*, Supreme Court of California, 116 Pacific 715.

NEW APPROPRIATIONS—

Where deeds executed by riparian owners conveyed land on both sides of a river, with the right to the grantee to divert such portions of the water as might be necessary for irrigating purposes along the line of a millrace, and also to propel by water power any flour or other mill which might thereafter be constructed by the grantee, his heirs or assigns, at or near the town of E., such language conveyed only a right to a partial diversion of the stream, and amounted to a license to appropriate only such water as was sufficient for the enterprise then in view, as actually applied to a useful purpose, within a reasonable time, so that additional water subsequently required, either for a new enterprise or a material enlargement of the old one, would constitute a new appropriation as against others who had appropriated water from the stream in the meantime.—*Andrews v. Donnelly*, Supreme Court of Oregon, 116 Pacific 569.

BREACH OF WARRANTY OF PUMP—

Where defendant purchased a pump from plaintiff after fully explaining all the requirements and plaintiff assured defendant that the pump would operate without pulsation, jar, or water hammer in the pipes as required, and, when installed, the pump would not carry a constant load and deliver water without pulsation, but caused water hammer in the pipes and was not reasonably fit for the purpose intended, there being a breach of both an express and implied warranty contemplated by Civ. Code, Secs. 1763-1766, 1770, and 1786, and, there being evidence justifying a reasonable inference that it was intended that such warranties should be regarded as a condition precedent to the sale, defendant was entitled to rescind and recover the money paid.—*Luitweiler Pumping Engine Co. v. Ukiah Water & Improvement Co.*, District Court of Appeals, Third District, California, 116 Pacific 707.

DITCH RIGHTS A CLOUD ON TITLE—

Where land was subject by a deed to an easement giving another right to enter thereon at any point by ditch or other waterway, conduct water from a certain creek for any industrial purpose and for irrigation, and to establish any suitable ditch, flume, or waterway not exceeding certain dimensions, and the further right to enter on the lands, and by suitable pipes placed in the ground conduct water from any springs thereon, subject to like rights granted to another, the owner was unable to convey "a full fee-simple title" as provided by the terms of a contract of sale.—*Wingard v. Cope land*, Supreme Court of Washington, 116 Pacific 670.

PRIORITIES BY RIGHT—

In view of the purposes of the Water Code (Laws 1909, p. 333) Sec. 47, as shown by the history of its enactment, the prior filing of an application for waters, etc., only gives priority of right where the application is for a public use available to the applicant or for a private use as by a settler, and the provisions of the act as to the application are fulfilled; the provision that no application shall lose its priority be-

cause of defects in the application which are remedied within 30 days being the only reference to priority of filing.—*Cook-inham v. Lewis*, Supreme Court of Oregon, 115 Pacific 342.

CONVEYANCE OF WATER RIGHTS—

Where claimant sold his stock in an irrigation company to his co-owner, and conveyed to the corporation a right of way over certain land for a spillway in consideration of \$500 payable on terms and \$35,000 in water rights, and the corporation defaulted in its contract to furnish water under the rights, and it was subsequently held that the conveyance of such water rights was invalid, claimant, having acted in good faith, was entitled to a reconveyance of the spillway as against defendant's receiver for failure of consideration.—*Pederson v. North Yakima & East Selah Irr. Co.*, Supreme Court of Washington, 116 Pacific 279.

RIPARIAN PROPRIETORS—

While a riparian proprietor is entitled to the ordinary and usual flow of a stream so long as it is of beneficial use to him, including under some circumstances flood waters reasonably to be expected during the ordinary seasons, a lower riparian proprietor was not entitled to restrain diversion of the flood waters of a stream by a nonriparian proprietor, where he was not injured thereby.—*Eastern Oregon Land Co. v. Willow River Land & Irr. Co.*, U. S. Circuit Court, District of Oregon, 187 Federal 466.

RECEIVERSHIP OF CANAL COMPANY—

Where the canal furnished by defendant, under obligation to furnish a canal suitable to carry the quantity of water to which plaintiff had a prior right, was ample and safely carried more than that quantity, the court, at the suit of plaintiff, was without authority to appoint a receiver to repair the canal, and the costs of the receiver appointed were properly charged to plaintiff.—*West Riverside 350-Inch Water Co. v. Rogers*, District Court of Appeals, Second District, California, 116 Pacific 683.

PREVENTING OVERFLOW—

Riparian owners of lands abutting upon a stream, whether navigable or nonnavigable, have the right to place and maintain upon their lands such barriers as will prevent their lands from being overflowed and damaged by the stream, and for the purpose of keeping the same within its natural channel.—*Fischer v. Davis*, Supreme Court of Idaho, 116 Pacific 412.

FLOOD WATERS—

Waters escaping from the banks of a river at times of flood are "surface waters," and not waters of the stream, and a property owner may defend himself against the same, though in so doing he may cause injury to another, unless he protects himself from injury by the waters.—*Harvey v. Northern Pac. Ry. Co.*, Supreme Court of Washington, 116 Pacific 464.

OVERFLOWS—

An upper riparian owner cannot obstruct a stream so that the lower riparian owners will have no benefit from the overflows which occur regularly in certain seasons.—*Still v. Palouse Irrigation & Power Co.*, Supreme Court of Washington, 117 Pacific 466.

EASEMENT TO MAINTAIN IRRIGATION DITCH—

Where the owner of land voluntarily consents to the construction of an irrigation ditch across the same, the right of the owner of the ditch to maintain and use it as built is absolute as against all persons.—*Arthur Irr Co. v. Strayer*, Supreme Court of Colorado, 115 Pacific 724.

ABANDONMENT—

Abandonment of an appropriation of water for irrigation is a question of intention to be evidenced by overt acts; but, when such overt acts appear, the right to appropriate water ceases and cannot be resumed as against intervening rights of others.—*Anderson Land & Stock Co. v. McConnell*, Circuit Court, Nevada, 188 Federal 818.

STATE ENGINEER—

The state engineer has no right, power, or authority to interfere with vested rights, or to grant a permit for the appropriation and diversion of the water of a stream, where the same has already been diverted and applied to a beneficial use.—*Nielson v. Parker*, Supreme Court of Idaho, 115 Pacific 488.

RIPARIAN OWNERSHIP—

In Nevada the doctrine of riparian ownership as a foundation for rights to water has been abandoned.—*Anderson Land & Stock Co. v. McConnell*, Circuit Court, Nevada, 188 Federal 818.

ABANDONMENT—

Where an irrigation company began work irrigating 40 acres of land at a time and then 20 acres, and then abandoned the irrigation of the land altogether, there was no such continuous use of the water taken for irrigation purposes as to confirm the original appropriation. *Still v. Palouse Irrigation & Power Co.*, Supreme Court of Washington, 117 Pacific 466.

CHANNEL OF WATERCOURSE—

Where, though a water course spread out over a meadow in delta formation and was broken up into several channels, it could be identified on the surface, and flowed in a defined course through low depressions, it was a natural watercourse, and subject to appropriation by the landowner, though there was no definitely defined channel on the surface. *Anderson Land & Stock Co. v. McConnell*, Circuit Court, Nevada, 188 Federal 818.

DELAY IN COMPLETING WORK—

Under Rem. & Bal. Code, §6318, providing that an appropriator of waters of a stream must diligently and continuously prosecute the construction of the works to completion, an irrigation company which after five years of construction and delay failed to complete its works had not used sufficient diligence to confirm an appropriation. *Still v. Palouse Irrigation & Power Co.*, Supreme Court of Washington, 117 Pacific 466.

APPROPRIATION OF WATER—

Section 3292, Rev. Codes, provides that when payment is made upon a perpetual water right the water right shall remain a part of the tract of land for which the same is purchased, and that the title to the use of said water can never be affected in any way by any subsequent transfer of the canal or ditch company, or by any subsequent foreclosure of any bond, mortgage, or other lien. *Hewitt v. Great Western Sugar Co.*, Supreme Court of Idaho, 118 Pacific 296.

CONSTRUCTION OF IRRIGATION DITCHES—

Where A institutes proceedings to condemn the lands of B for the purpose of constructing an irrigation ditch over lands of B, which are already traversed by a prior ditch, which has been extended to the line of A's land, injunction is the proper remedy for B; and in such a suit the burden is upon A to show that the first ditch cannot be made to answer the purpose for which the second ditch is desired or intended. *Walker v. Anderson*, Supreme Court of Nebraska, 132 Northwestern 937.

RIGHT TO USE OF WATER—

Where a person, not a party to a statutory proceeding to determine the priorities of right to the use of water for irrigation, appeared voluntarily after decree and objected to a clause therein establishing a right of way over his land for a ditch, and filed a petition praying for a vacation of the clause, an appeal by him from an adverse order must be taken and perfected in the manner prescribed by the statute authorizing the proceeding, and not in the manner prescribed for the taking of appeals in civil actions. *Haines v. Fearnley*, Supreme Court of Colorado, 117 Pacific 162.

ESTABLISHMENT OF IRRIGATION DITCHES—

In a suit to enjoin proceedings instituted by one landowner to construct a ditch for irrigation purposes across the lands of an adjoining owner, which are already traversed by another ditch, the question is not whether the first ditch is then in a sufficient state of repair or in a condition to answer the purpose for which the second ditch is desired or intended; the question is, Can the first ditch be made to answer such purpose? If so, no right exists to construct a second ditch. *Walker v. Anderson*, Supreme Court of Nebraska, 132 Northwestern 937.

VALIDITY OF IRRIGATION CONTRACT—

One who merely owned an irrigation canal not shown to have been constructed under Rev. St. 1895, art. 3125, imposing on the owner certain duties as to furnishing water, with a lateral running through plaintiff's land with his consent, and who agreed to furnish plaintiff water to irrigate his rice crop, could make a valid contract limiting damages from his failure to do so to a certain sum per acre; the irrigation plant owner not undertaking the discharge of a public duty, so that the reasonableness of the provision of the contract is for the parties to decide. *Granger v. Kishi*, Court of Civil Appeals of Texas, 139 Southwestern 1002.

ADVERSE CLAIM—

Where defendants claimed a prior right to the waters of a stream by adverse possession, evidence that on one occasion, when plaintiff's ditch tender had turned the waters of the creek into plaintiff's ditch, C, acting for defendants, immediately caused the waters to be turned back, and on meeting the ditch tender threatened him with violence if he ever interfered with the water again, and stated to him that if his employer wanted the water he should come up and arrange for it, to which the ditch tender apologized and promised never to interfere with the water again, was admissible as evidence of defendants' continued assertion of right made to an agent of the adverse claimant. *Edson & Foulke Co. v. Winsell*, Supreme Court of California, 118 Pacific 243.

IRRIGATION COMPANIES—

Rev. St. 1895, art. 3125, authorizes corporations to be formed to operate canals to conduct water to persons entitled thereto for irrigation, with power to make contracts for the sale of permanent water rights, and requires that all persons owning land contiguous to any irrigation canal who shall have secured the right to use the water in such canal shall be entitled to be supplied therefrom pursuant to their contracts, and, if the canal and landowners fail to agree upon the price, the canal operator shall furnish necessary water to the landowners at such prices as may be reasonable and just, and other articles provide for the condemnation of land for irrigation canals. *Held*, that one maintaining an irrigation canal under the statute could not impose unjust or unreasonable terms by contract upon water users; any such terms being void. *Granger v. Kishi*, Court of Civil Appeals of Texas, 139 Southwestern 1002.

IRRIGATION RESERVOIR ON SCHOOL LANDS—

Act March 9, 1895 (Acts 24th Leg. c. 21); makes unappropriated waters of streams public property subject to appropriation for irrigation purposes, provides for the construction of dams or reservoirs for the storage of such waters for irrigation, and authorizes the formation of corporations to construct and maintain ditches, reservoirs, and dams for irrigation purposes. An irrigation corporation sought to establish dams and reservoirs on public school lands. No land suitable for the construction of a reservoir could be found within 40 miles of the one located by the corporation, so that, unless the corporation could establish reservoir sites on public school lands, it could not accomplish the purpose of the act. *Held*, that the corporation had, under the act, the right to acquire an easement in the school lands for the purpose of a dam and reservoir site as granted by implication. *Imperial Irr. Co. v. Jayne*, Supreme Court of Texas, 138 Southwestern 575.

STOCKHOLDERS IN IRRIGATION SYSTEM—

Defendant, who had purchased land within an irrigation system being constructed under a contract with the state, bought stock in the corporation organized to maintain and operate such system which entitled him to water for irrigation of his land, entering into a contract by which he made an initial payment and agreed to pay the remainder in annual installments. The contract provided that he should pay the first installment, with interest on all, November 1st following, but further, in accordance with the requirement of the contract with the state for construction of the system, that interest should be payable from April 1st if water was available for irrigation of the land during the irrigation season, but, if not, to commence when such water was available; that "no payment other than the initial payment, and no interest shall be required to be paid under this contract until the water is available * * * and such water must be available at the beginning of the irrigation season in order to make such payments become due, and all payments and interest * * * shall be advanced in time according to the delay in the delivery of the said water." The contract was secured by a lien on the land and with other like contracts, and, as provided therein, was assigned to a trustee to secure bonds of the corporation. The irrigation season extended from April 1st to November 1st, and water was not available for defendant's land until May 14th. *Held* that, under such contract, no payment of interest or principal became due or collectible by the assignee until one year from the 1st of the ensuing November, and that interest commenced to run from the 1st of April of the next season. *Continental & Commercial Trust & Savings Bank v. McCarty*, U. S. Circuit Court of Appeals, 188 Federal 273.

Reclamation Notes

CALIFORNIA.

Fred E. Fay of Los Angeles, and eastern associates have purchased a quarter section of land adjoining the town of Lois, which will be cut up into ten-acre tracts and planted to oranges. The land is reported to be very level, is well sheltered and it is said to be underlaid with water. A fine irrigation system will be installed.

Prospects for securing irrigation of lands in the district known as White Lake in Siskiyou county are favorable at this time. The Van Brimmer Ditch Company has made an agreement to permit J. H. Wise and others to use water from the company's canal. A new company is being formed to use the ditch water supply and they propose to take about fifty cubic feet of water per second from White Lake to a point near Brownell, where it will be lifted by a pumping plant and then spread over the land to be improved by two ditches which will be dug.

Work on the diverting dam of the Oakdale and South San Joaquin Irrigation districts in the Stanislaus river, above Knight's Ferry, is progressing rapidly. The cofferdams are in and the dam site is unwatered. The rock on the bottom of the river will be excavated to the depth of four feet to avoid all possible faults in the rock, thus insuring a stable foundation.

The management of the Lutheran Colony Company of Red Bluff has filed on 8,000 inches of water in Little Antelope creek for irrigation and domestic purposes. The water will be diverted by a stone or masonry dam and distributed by flumes and ditches over the lands.

In order that the original number of acres may be contained in the Orland Irrigation project, the government will sign up 600 acres outside of the present boundaries of the project to replace 600 acres which will be lost by the withdrawal of water supply from the town of Orland from the undertaking.

The Siskiyou Irrigation Association held a meeting in Montague recently to act on the report submitted by its engineer, J. E. Ludy, concerning the irrigation of 120,000 acres of land in the Big and Little Shasta valleys. The system, it is estimated, will cost about \$835,000. Water will be taken from Klamath river above Klamath Hot Springs.

A. Collins, a San Francisco engineer, has filed a water location for 300,000 inches to be taken from the Sacramento river at the mouth of Redbank creek, three miles below Red Bluff, to be used for irrigation in Tehama, Glenn, Colusa and Yolo counties.

Emory Wishon of Coalinga has leased 4,800 acres of land two miles east of that city and will install an irrigation plant to bring the land under cultivation. This land has been known as the Pleasant Valley stock farm.

The West Side Irrigation District is promoting plans to irrigate 8,000 acres of rich land in the Imperial valley. Papers are being prepared for incorporation under the state law as a mutual water company. Practically all of the land that will be embraced in this district has been filed upon. The soil is of a sandy character, has a light gravel coating in some sections, and is very fertile.

The Elkhorn Land Company of Woodland, Yolo county, has filed a petition with the Board of Supervisors for the organization of a reclamation district embracing 1,241 acres of land. The proposed district lies between Woodland and Elkhorn and west of the Sacramento river.

The Surprise Valley Water Company, whose main office is located in Los Angeles, has let the contracts for the building of an irrigation system in Surprise valley at an estimated cost of \$350,000. Water will be supplied to land owners at a cost of \$35 per acre, with eleven years in which to make the payments. Thousands of acres of rich land will be brought under cultivation through this project and the development work has already begun. The Provident Investment Company is financing the water system.

To pay off an indebtedness of \$39,000 before the consolidation with reclamation district No. 108, an assessment will be levied on the property in district No. 729.

COLORADO.

The total outlay for the Uncompahgre Valley irrigation project up to November first of this year amounts to an average of \$32.47 per acre. The project is considerably more than half completed.

One of the most extensive irrigation pumping plants in Weld county is being installed on the ranch of W. H. Arnett near Nunn. This pumping plant comprises a 40-foot well and a 100-foot tunnel.

At a recent meeting of the directors of the Nepesta Ditch & Reservoir Company, held in Pueblo, the following officers were elected for the ensuing year: John H. Voorhees, president; A. E. Trus, vice-president; Chas. S. Essex, treasurer, and E. F. Nichols, secretary. The company expects to spend \$100,000 during the winter on the completion of the Nepesta irrigation project, which lies southeast of Pueblo, and in extensions of the canals and laterals of the company. The main canal will be extended to reach lands not now under cultivation.

Stockholders of the Fort Bent Ditch Company held a meeting in Lamar recently and decided to borrow \$12,000 with which to build a new dam and to redeem their outstanding indebtedness.

After four years of waiting, nine of the thirteen claimants whose homesteads on the Redlands were contested in 1907, have received their patents and placed them on record with the county clerk. Over 6,000 acres of land, all of it within ten miles of Grand Junction, was filed on in 1905. Eastern capitalists were attracted to the project and built the irrigation system. Charging an irregularity in the homesteading, thirteen of the claims were contested in 1907. The contests were taken up before the United States land office at Montrose, where the contestants won. It was appealed to the general land office at Washington, D. C., and the claimants again lost, but in 1910 the Secretary of the Interior ruled in favor of the claimants. It is stated that the remaining four of the thirteen will receive their patents from Washington in the near future.

Ranchmen in the vicinity of Grand Junction have started plans for the formation of an irrigation district for the patented land in that section. Pennsylvania capitalists have already started the construction of a \$2,000,000 irrigation system in that section.

B. H. Tallmadge, former general manager of the Pueblo-Rocky Ford Irrigation Company and the Pueblo-Rocky Ford Land Company, who some months ago filed a \$750,000 suit against the two companies, now asks the court to appoint a receiver to take over all their properties and assets and for an injunction restraining the officers and directors from disposing of any of the stocks, bonds or other assets. Tallmadge asserts that these two companies were formed for the purpose of swindling prospective purchasers of land and water rights. The Pueblo-Rocky Ford system is situated just southeast of Pueblo and the company has spent \$3,000,000 preparing reservoirs and canals to irrigate 50,000 acres of land.

IDAHO.

Negotiations that will assist in clearing the way for the launching of the big Bruneau irrigation project, consisting of approximately 600,000 acres of land located west of the Twin Falls south side project and south of the Snake river, were brought before the State Land Board recently when a representative of the Twin Falls Land & Power Company presented to Governor Hawley for his signature the applications of the state to the Department of the Interior to segregate land from the public domain into a Carey Act project whereby the large body can be set aside and the state can proceed with the working out of the final details and the promoting company can go ahead with the building of its irrigation system. The project calls for the expenditure of approximately \$20,000,000.

Fourteen thousand acres of rich fruit land will be opened to entry on December 11th, at Jerome, Idaho. The tract is to be irrigated by modern pumping system. The land is segregated under the Carey Act and the opening will be conducted by the State Land Board. Entries may be filed for 40, 80, 120 and 160-acre tracts.

The State Land Board has given notice of its intention to consider the complaints against the Blaine county irrigation project near Howe. The settlers claim that the promoting company does not deliver sufficient water to enable them to properly irrigate their land.

The State Land Board is taking steps to complete the Big Lost River irrigation scheme, the company that began that work being bankrupt. The proposition is to issue receiver's certificates to the amount needed to complete the work, these certificates to be paid for from the revenue that would ensue.

OREGON.

A company has been formed in Portland to promote an irrigation project about thirty miles southeast of Canby in Clackamas county. If the present plans are carried

out this company will erect the highest irrigation dam in the world. It is proposed to construct a reinforced concrete dam on the Malalla river which will have a height of 290 feet and will spread from a width of six feet at the bottom to 490 feet at the top. A reservoir will be formed that will store water sufficient to irrigate 100,000 acres of land. The estimated cost of this structure is \$1,500,000. It will be a private enterprise. Five-acre tracts will be placed on the market.

The Kingman Colony Irrigation Company of Owyhee, has let the contract for the construction of an irrigation project to reclaim 10,000 acres of land in eastern Oregon, ten miles south of Nyssa, to James A. Green & Co., Engineers, of Chicago. The contract calls for the delivery of water in 1912. Water will be taken from the Snake river. Irrigation through the medium of pumps will be demonstrated on this project, the first of its kind launched in that section of the west.

The Oregon Valley Land Company of Lakeview has sold its entire holdings to the Goose Lake Valley Irrigation Company. The transferred land includes a mammoth irrigation system which takes water from a large storage reservoir in Drew's Creek canyon at the point where it leaves the hills to enter Goose Lake valley.

W. J. Furnish, promoter of the Furnish irrigation project near Stanfield, has made an assignment of his entire interest in the reclamation of 5,000 acres of land to G. W. Sherwood of Spokane, Wash. It is announced that a far-reaching colony scheme for securing bona fide settlers will be launched.

UTAH.

A tract of land embracing 15,000 acres of fertile soil is being thrown open to settlement by the National Savings & Trust Company of Salt Lake City. The tract of the Delta Land & Water Company comprises 43,000

(Continued on page 74.)

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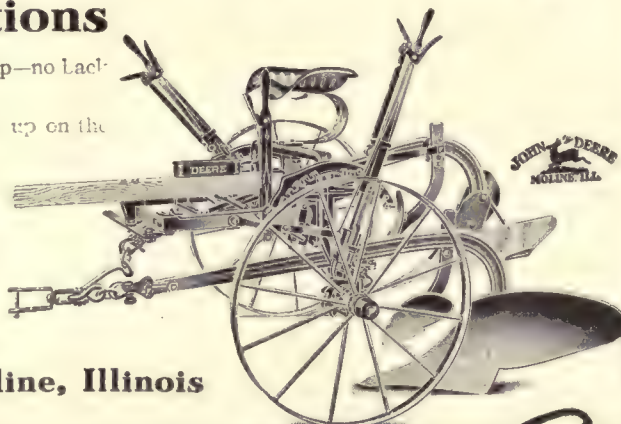
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EXTENDING THE WORK OF THE DEPARTMENT OF AGRICULTURE.

Secretary Wilson some time ago ordered the Weather Bureau to prepare for publication meteorological charts of the North and South Atlantic and the North and South Pacific and the Indian Oceans, and of the Great Lakes, and these charts are now being distributed. In collecting the data utilized in the preparation of these charts, the services of 2,416 co-operative marine observers have been enlisted, and 10,669 books of weather reports have been issued for their use. The popularity of the meteorological charts continues undiminished among ship-masters. The wireless telegraph service and the vessel reporting service, the first conducted through co-operation with various wireless telegraph companies and the latter at the sea-coast stations of the Atlantic and Pacific coasts, have been particularly serviceable to marine interests. Twelve wrecks occurred between Cape Henry and Hatteras during the year, all of which were reported by the Live Saving Service to the officials in charge of the Weather Bureau telegraph stations at Cape Henry, Hatteras, and Manteo, who promptly telegraphed the information to agents, owners, and others interested. It is estimated that fully \$328,250 was saved through the assistance rendered the vessels as the result of these reports. Timely information of 18 casualties on Lake Huron, in which property valued at \$350,000 was endangered, was also given out from the Weather Bureau station at Alpena, Mich., as a result of information received over Weather Bureau land and cable lines.

By further direction of Secretary Wilson the Weather Bureau and the Forest Service are making an exhaustive study of the entire question of forest effects upon climate and streamflow. The experiment station at Wagon Wheel Gap, Colo., established for the purpose of this investigation, is now on a firm basis, and a complete series of observations has been made during the last eight months. Co-operative meteorological stations are also maintained in the Coconino National Forest in Arizona, and in the Fremont National Forest in Colorado, data from which will be available for study and comparison in connection with the records at Wagon Wheel Gap. However, it should be understood that results obtained in this semi-arid region would be without value as a criterion for determining problems in connection with runoff that obtain in the humid regions of the East. It is hoped that in course of time an experimental area may be secured and the necessary plant installed in both the Allegheny and White Mountain regions.

WHAT OUR RIVERS CARRY.

The Colorado river discharges during an average year into the Gulf of California 338,000,000 tons of mud and silt as suspended matter. In addition to this the dissolved substances in the water include 4,550,000 tons of sodium chloride, or common salt; 3,740,000 tons of Glauber's salts; 4,000,000 tons of lime; 2,400,000 tons of gypsum; and 4,800,000 tons of Epsom salts. In spite of all this dissolved material the Colorado at its mouth is not considered to be a stream of unusually high mineralization for that region of the country. The reason is that the river also carries so enormous an amount of water that the dissolved salts constitute a comparatively small proportion of the total discharge. Other streams in the country contain dissolved salts in greater concentration—for example, the Elm Fork of Red river, in Oklahoma, discharges nearly 1,300,000 tons of common salt annually. Although this amount is not so great as that discharged by the Colorado it is much greater in proportion to the size of the area drained. The discharge of salt from the Colorado is equal to 20 tons annually to each square mile drained by the river, but the salt in Elm Fork of Red river is equal to 1,680 tons per square mile of area drained. The same river discharges annually 177,000 tons of magnesium chloride, 168,000 tons of Epsom salts, 690,000 tons of gypsum, and 54,000 tons of lime. These quantities, too, are considerably greater than those carried in the Colorado in proportion to the size of the drainage area.

Belle Fourche river, at Belle Fourche, S. Dak., discharges 191,000 tons of gypsum, 79,000 tons of Glauber's

(Continued on page 73.)

AN OFFICIAL VISITOR FROM INDIA.

That a state in Central India should send a representative to America to study irrigation and other principles of farming is one of the marvelous facts of the day. Mr. S. V. Kadam, an educated native belonging to one of the high castes, has been in the United States for several weeks investigating farming conditions, particularly the use of modern machinery. After going west in Canada as far as Calgary he came over to this country and attended the Colorado convention, since which he has spent most of his time in and around Chicago. The gentleman is a special representative of H. H. the Maharaja Scindia of Gwalior, one of the wealthiest and most progressive reigning princes of India. He made a careful study of farm machinery here and will report on its merits and cost as soon as he reaches home. His trip, like that of Prof. McIntosh of South Australia, will amount to nearly 40,000 miles by the time he has closed his investigations.

One of the odd things about his visit to America was his purchase of a collection of breakfast foods, especially those made from corn and wheat, grains which are common in India. Although the natives live chiefly on corn they know little about its varied uses, and the breakfast foods were a great novelty to the visitor, as they will be to his sovereign, for whom Mr. Kadam bought a supply. His state is naturally wealthy, but in agriculture is strangely backward. There is little machinery at present, but as an awakening has come under the progressive reigning prince it is probable matters will soon take on a modern aspect. Chicago dealers expect to sell a large order, or several of them, as soon as the visitor is able to make his official recommendations.

Mr. Kadam stated to THE IRRIGATION AGE that he had learned much since coming to America that will be of interest and importance to his people. He declares that the United States leads the world in machinery, but not in economy of production. There is better farming in Europe, and methods will improve here, he assumes, as land values advance and people are forced to take smaller tracts. It is the cheap land that has caused wasteful methods in this country. This fact is seen at a glance by visitors. Mr. Kadam has visited nearly all the large cities of the United States. It seems almost beyond belief to a man from India that a place like Chicago can be developed in a period of a hundred years. Equally wonderful to him was the sight of motor plows and reapers in the great wheat fields of the Northwest.

One dollar per annum brings THE IRRIGATION AGE to you for a whole year. Just think of all the good and useful reading matter pertaining to your work you are getting for this little sum.

CEMENT PRODUCTION IN UNITED STATES BREAKS RECORD.

Ten years ago the production of Portland cement for the first time passed the 10,000,000-barrel mark, showing an increase of 2,600 per cent over the production of 10 years previous, and the giant strides that had been made in the industry were widely remarked. Even this production was small compared with that of the present day. In 1910, according to the report on cement by Ernest F. Burchard, of the United States Geological Survey, the production of Portland cement reached the enormous total of 76,549,951 barrels, with a value of \$68,205,800. This is equivalent to 12,986,152 long tons, valued at \$5.25 a ton. It is an increase over the output for 1909 of 11,558,520 barrels, or nearly 18 per cent, and an increase in value of \$15,347,446, or more than 29 per cent. This increase alone is greater than the total output of Portland cement in 1900. In addition to Portland cement there was also produced last year 1,139,239 barrels of natural cement and 95,951 barrels of puzzolan cement, a total of 77,785,141 barrels.

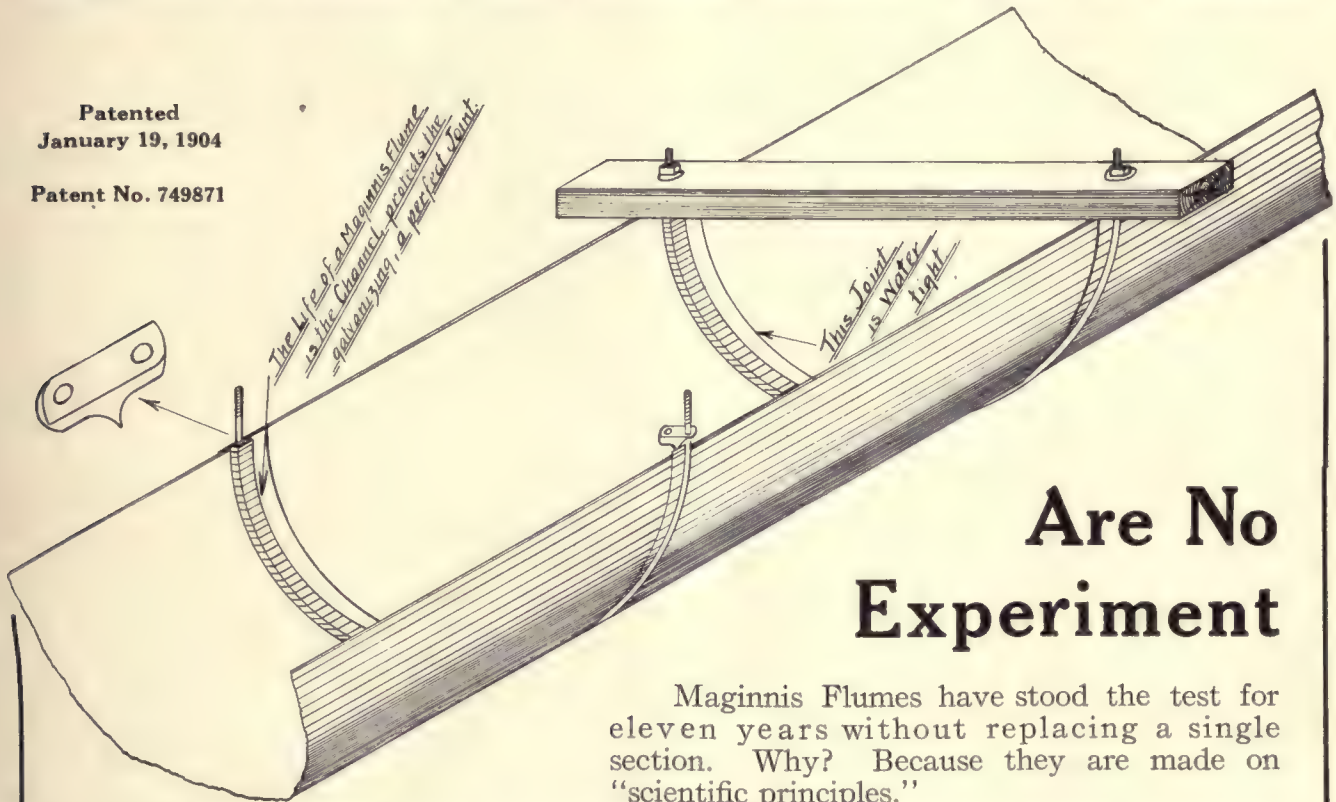
The price of Portland cement in 1910 was as low as 73 cents a barrel in some places, the average for the United States being 89.1 cents a barrel. In 1890 the aver-

(Continued on page 76.)

Maginnis Standard Galvanized Steel Irrigation Flumes

Patented
January 19, 1904

Patent No. 749871



Are No Experiment

Maginnis Flumes have stood the test for eleven years without replacing a single section. Why? Because they are made on "scientific principles."

The inner binder (which is part of the splice on the Maginnis flume) is made to check a silt in the bottom of the flume which protects the galvanizing. Without galvanizing a metal sheet will not last any longer than a stovepipe would if out in all kinds of weather.

The life of the Standard Maginnis Flume is the Channel Binder, because of the protection given the galvanizing, not only by checking the silt but by checking the sand (which is more or less common to all irrigation water), which if permitted to travel through a flume with the same velocity as water would cut the galvanizing off and leave a plain sheet of metal. You know the results.

I am speaking from experience. To be exact, January 19, 1904, I received Patent Number 749871 for smooth inside flume. I, like a good many others, thought I had everything that was needed. At my own expense (not yours) I tried this flume out, more to determine the actual carrying capacity for measurements, etc., than anything else; to my sorrow I found that the sand would cut off the galvanizing when carried by the water through a smooth inside flume. I did not impose on my customers by putting this flume on the market, but continued to make the old reliable "MAGINNIS FLUME" which has now stood the tests for eleven years and given entire satisfaction.

A word about patents: I am the sole owner of the Maginnis Flumes patents, which were issued in 1902-1904 and cover inner and outer clamping members, inner binders, carriers rods, etc., in other words the only method of connecting two sheets of metal together and making them water-tight, without using rivets or solder. First used by P. Maginnis in experiments in 1901.

For further particulars address

P. MAGINNIS - - KIMBALL, NEB.

OREGON'S IRRIGATION STATISTICS.

Census Director Durand has issued the first official statement from the Census Bureau relative to the statistics on irrigation in Oregon. It is based on a preliminary comparative summary submitted by Dr. Le Grand Powers, chief statistician of the division of agriculture in the Bureau of the Census, under whose supervision it was prepared by R. T. Teele, special agent in charge of irrigation.

This summary shows for both 1909 and 1899 the number of farms irrigated, the acreage irrigated, the total cost of irrigation systems, and the average cost per acre irrigated. It shows also for the year 1909 acreage irrigated with pumped water and the average annual cost of maintenance and operation. It shows for 1910 the acreage which existing enterprises were capable of supplying, the acreage included in existing projects, the number of independent enterprises, total length of ditches, number of reservoirs, capacity of reservoirs, number of flowing wells, number of wells pumped for irrigation, the number of pumping plants, and engine capacity of pumping plants. The acreage irrigated is classified by the type of enterprise supplying water and by the source of water supply.

It should be noted that the figures are subject to revision after more complete tabulation, but it is not expected that there will be any material modification of the totals or percentages reported.

The total number of farms irrigated in 1909 was 6,669, against 4,636 in 1899, an increase of 2,033, or 43.9 per cent. Within the same period the number of farms in the state had increased 27 per cent, indicating that irrigation is increasing more rapidly than dry farming in the state.

The total acreage irrigated in 1909 was 686,129 acres, against 388,310 acres in 1899, an increase of 297,819 acres, or 76.7 per cent. During the same period the improved acreage of farms increased 28.4 per cent, indicating again the rapid advance of irrigation. The area irrigated was 16.1 per cent of the improved land in farms in 1909 and 11.7 per cent in 1899.

The total acreage which all enterprises were capable of irrigating in 1910 was 830,526 acres, an excess of 144,397 acres over the area irrigated in 1909. The acreage included in projects either completed or under construction in 1910 was 2,527,208 acres, an excess of 1,841,070 acres over the area irrigated in 1909. This indicates the area which will be available within the next few years for the extension of irrigation, and shows that the area irrigated can be almost tripled without the construction of additional works.

The number of independent enterprises reported in 1910 was 3,745. The total length of main ditches in 1910 was 5,649 miles, against 2,283 miles in 1899, an increase of 3,366 miles, or 147.4 per cent. The number of reservoirs reported in 1910 was 276, having a combined capacity of 1,317,370 acre-feet. The number of wells pumped for irrigation was 91 and the number of pumping plants 229. The engine capacity of pumping plants was 3,278 horsepower. The acreage irrigated with pumped water was 5,711 acres.

The total cost of irrigation systems reported in 1910 was \$12,689,044, against \$1,843,771 in 1899, an increase of \$10,845,273, or 588.2 per cent. The average cost per acre in 1910 was \$15.28, against \$4.75 in 1899, an increase of \$10.53, or 221.7 per cent. The average cost of operation and maintenance per acre in 1909 was 75 cents, against 22 cents in 1899, an increase of 53 cents, or 240.9 per cent. This makes 22,000 acres, or 3.2 per cent of the total; United States Indian Service (various acts of Congress), 429 acres, or 0.1 per cent of the total; Carey Act (act of Congress, Aug. 18, 1894), 24,750 acres, or 3.6 per cent of the total; irrigation districts, 1,500 acres, or 0.2 per cent; co-operative enterprises, 149,985 acres, or 21.9 per cent; commercial enterprises, 77,387 acres, or 11.3 per cent; and individual or partnership enterprises, 410,078 acres, or 59.8 per cent. Works built by the United States Reclamation Service and by the Carey Act enterprises are to be turned over to the water users for operation and maintenance. Including these, 88.7 per cent of the acreage irrigated in 1909 was supplied by works controlled by the water users.

Streams supplied 646,866 acres, or 94.3 per cent of the total acreage irrigated in 1909; lakes supplied 23,736 acres, or 3.5 per cent; wells supplied 1,460 acres, or 0.2 per cent; springs supplied 10,788 acres, or 1.6 per cent; and reservoirs supplied 3,279 acres, or 0.5 per cent.

PLACER GOLD IN NORTHWESTERN MONTANA.

Many glacial moraines contain particles of gold, yet the metal is very rarely so abundant as to make their treatment profitable. This is due to the fact that running water has not had opportunity to concentrate the precious metal scoured by the glacier from the decomposed surface of the mountains. In a short report, however, just issued by the United States Geological Survey, F. C. Schrader gives an interesting account of gold-bearing ground moraines at Kennedy Creek and Libby Creek, Montana. The Kennedy Creek deposit, says Mr. Schrader, is commonly known to mining men who have examined it as ancient lake gravel, but it seems plainly to be a subglacial or ice-laid deposit of till—a ground moraine. The material is evidently derived from the upland mountains on the northeast, whence it was scoured off the surface by the ice sheet, shoved and dragged down the slopes, crushed, ground, and finally compressed beneath the ponderous ice mass. The ice sheet probably covered the basin with a thickness of a thousand or more feet for a period of centuries.

A most unusual feature is the fact that this glacial deposit does not seem to have been concentrated by later streams nor to have derived its gold from pre-existing placers. If this view is correct there must occur in the mountains or uplands to the northeast, in the path of the ice that deposited the moraine, some rich gold-bearing vein or bedrock area as yet undiscovered.

Tests made of the deposit in six different shafts fairly well distributed over about half a square mile in the southern part of the basin show the gold content of the deposits to range from 20 cents a cubic yard near the surface to about \$5 a cubic yard in the bottom foot of gravel next to bedrock, from which it is readily apparent that the deposits contain considerable gold. By some mining men the amount of gold present in the basin has been estimated at \$18,000,000. From the data contained in the present tests, after reasonable allowance is made for bowlders, which in the lower part of the section constitute about 10 per cent of the material, the deposit in the southern part of the basin seems to contain on the average about 80 cents a cubic yard, including everything from the surface down to bedrock, or about \$4 a bedrock yard. This would amount to about \$17,360 an acre, or more than \$5,500,000 for the Kennedy placer portion of the area examined. The estimate does not include the neck of the deposit in the downstream outlet, which in places attains a thickness of 80 feet or more and is known to carry considerable gold. In the basin as a whole, if gravel of this grade is present throughout, there is probably more than \$11,000,000 worth of gold.

The entire district of which Kennedy Creek is a portion is roughly estimated by Mr. Schrader to contain about \$100,000,000 worth of gold, much of which, he states, to judge from the attention the district is receiving, will probably be won in the near future. A copy of Mr. Schrader's report, which is contained in Bulletin 470-B, may be obtained on application to the Director, United States Geological Survey, Washington, D. C.

HONEY A WELL PAYING SIDE LINE.

A profitable industry is being developed on many of the government irrigation projects in the production of honey, and press reports from recent state and county fairs indicate that the quality of this honey is superior. The flavor is exceptionally fine and the color clear and sparkling. Alfalfa is the chief source from which the bees secure their supply, and as it blooms constantly from early spring until late in the fall the bees have something to work on all the time, allowing a greater amount of honey to be stored.

Many of the projects are located in famous fruit sections and the combination is found to be of mutual advantage. The trees furnish an abundance of honey during the blossoming period, and orchardmen state that the economic importance of the bee, from the standpoint of its value in the pollenization of fruit, cannot be overestimated. White clover and small fruits, and in the plains regions many varieties of wild flowers also furnish sources of supply.

The bee industry is a lucrative side line for the regu-
(Continued on page 72.)

Apples Grow Big and Red
and Round in the famous

Pecos Valley

New Mexico—Texas

During the past
year several
thousand acres of
new Apple land
have been put under
the ditch.

Buy now and make
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Write to me today. Ask for copies of the Pecos Valley folder and the Special Number of the *Earth*. If there is anything you are particularly curious to know, ask the question. I will answer as completely as I can. But ask for the folder. It's free.

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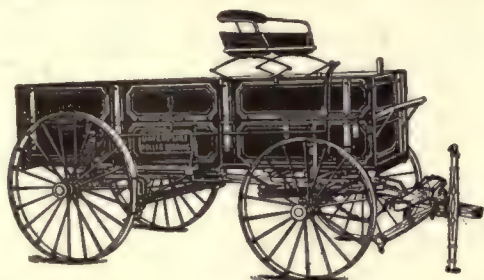
The reputation of the Pecos Valley of New Mexico and Texas for fertility of soil, abundance of irrigating waters, variety and quality of produce and salubriousness of climate long has been established.

The apples from this valley have won favor in the markets of the East and command a premium in London and other European cities. The famous pea-green alfalfa is in demand everywhere and commands a premium of from \$1 to \$1.50 a ton wherever offered. Heretofore the area over which these and other crops could be grown has been restricted by the fact that gravity water and the artesian flow would not carry above the second bottom. Thousands of fertile acres lying on benches just out of reach of the gravity canals were undeveloped. But a change of methods has come about. Wells have been put down and pumping plants, individual and communal, have been established, with the result that an immensely larger area has been brought under the ditch and several thousand acres of new apple land and as much more alfalfa land is awaiting the advent of industrious, ambitious men.

These lands are capable of the most intensive cultivation and they will pay large returns on the prices now being asked. There is still considerable land to be had in the valley proper, with water obtainable from the established canals built by private enterprise or by the government reclamation service; also from the flowing wells in the artesian belt.

You should investigate this splendid valley, learn at first hand what has been done by others and what you can do if you will. There's big money in the Pecos Valley for the man who will work.

We invite you to take advantage of the information we have in this office covering the valley. It is yours for the asking and at no expense to you. Write today. Don't wait until the price of land goes up. Get that extra profit yourself. Better still, go down and see. You can go on the first and third Tuesday of the month and the railway fare is very low.



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The only equipment that will stand the climate of the irrigated district, is made of steel. You know the reason. Wood dries out, becomes useless, and the machinery falls apart.

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are THE wagons for the "Dry Farming" country. Not affected by the climate. Stronger, lighter draft and more durable; outlast several wooden wagons.

Built of steel I-beams, Channels and Angles, solidly riveted with large steel rivets, put in hot, making the gear parts practically one piece.

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No bolts to become loose and nuts to rattle off on account of parts shrinking or drying out. The DAVENPORT is constructed like the modern steel railroad bridge. Trussed and braced to withstand all strains. Built for the heaviest lifetime service.

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It makes no difference what the climate is, it does not affect the wheels on the DAVENPORT. They are made with a tension, each spoke carrying its share of the load all the time, whether it is on the top, bottom or side of the wheel. The spoke heads are countersunk in the tire; headed and shouldered in the hubs. The strongest wheels ever put on a wagon. No split felloes or cracked hubs. No repair bills to pay.

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Write NOW for all the information. Improve your farm by being able to do more work with the same horses and help. BE SURE and ask for PACKAGE NO. 45.

Davenport Wagon Company, Davenport, Iowa.

COST OF FILLING SILO.

A Nebraska farmer figures on the cost of silage: "The drouth has caused my hay crop to be very short, but I do not know whether I can afford to use the corn for ensilage or not. What does it usually cost per ton?"

The cost of ensilage per ton depends very largely on the value of the land, and the kind of corn crop that is grown. We have known of instances where it required but eight acres to fill a hundred-ton silo, and other instances where it would take at least twenty-five acres. For this reason the cost of filling a silo depends on the amount of forage per acre more than on the cost of labor involved, which is one of the smallest items.

Prof. Haecker, of Nebraska Station, after carefully taking into consideration all the factors which enter into the production of corn estimates the cost of putting up a ton of ensilage at \$1.95. Some Iowa farmers have computed the cost as low as \$2.15 per ton; others have gone as high as \$2.49.

Prof. Mumford, of Illinois, has computed the cost of ensilage, figuring the value of corn at 35 cents per bushel, to be approximately \$2.75 per ton. On an average it will cost you from \$2.00 to \$2.50 per ton for filling your silo. This is a very small price to pay for ensilage when compared with hay and other feeds, which will range from \$10.00 and up per ton.

MOUNT M'KINLEY REGION.

The great crescentic sweep of Alaska's southern coast line is broken at its most northerly point by Cook Inlet, named after the famous explorer of the eighteenth century, an embayment which penetrates the mainland for nearly 200 miles. The drainage basin tributary to Cook Inlet is cut off from the Yukon and the Kuskokwim waters on the north and west by a chain of rugged mountains known as the Alaska Range, at the heart of which towers majestic Mount McKinley, the highest peak of North America, and its sister peak Mount Foraker. Previous to 1902 this region constituted a great block of unknown territory. When in 1898 the United States Geological Survey began its task of exploring, surveying, and studying the mineral resources of Alaska, the first work was of necessity merely exploratory, for until the larger features of drainage and relief had been outlined it was impossible to plan topographic and geologic surveys. The demand of the prospector was for maps and information to guide him in hazardous journeys. From 1898 to 1902, therefore, the Alaskan work of the Geological Survey was largely a series of reconnaissances, covering wide areas and outlining the larger physiographic features—a skeleton to be gradually filled in by detailed mapping. But the Mount McKinley region remained untouched. Plans for its survey had been considered as early as 1899, but it was not possible to put them into effect until 1902.

"The Mount McKinley Region of Alaska," by Alfred H. Brooks, just issued by the Geological Survey as Professional Paper 70, describes this work of early exploration of a vast tract of territory absolutely unknown and incomparably wild. The report is a large volume describing the geologic, geographic, and mineral resources of the region, but Mr. Brooks' brief description of the trip itself is a tale of real adventure. In 105 days the party, consisting of 7 men, penetrated 800 miles of an unknown wilderness with almost impassable swamps, unfordable rivers, and lofty snow-covered mountains. These men depended largely on their guns for provender, but finally accomplished their purpose of striking through the Alaska Range and coming out into the interior Yukon valley, a feat which was looked upon by the natives as impossible. Starting from Tyonek on Cook Inlet on June 2, the party struck inland.

"Although the Indians and traders agreed," says Mr. Brooks, "that with good luck we might be able to get across the Alaska Range, no one believed it possible that we could extend our work to the Tanana, much less to the Yukon. It was the general expectation that the party would return to Cook Inlet in the fall. This might have

(Continued on page 77.)

When writing to advertisers please mention The Irrigation Age.

(Continued from page 58.)

Alfalfa is an exception, and it nearly always pays to supply its bacteria artificially. This may be done very inexpensively. Obtain soil from some near-by alfalfa field and apply it at the rate of one hundred pounds per acre, sowing it late in the afternoon and harrowing it in immediately before allowing the sun to strike it. This is the best way to inoculate. Soil from around the sweet clover or melilotus roots answers equally well. The government will furnish inoculation of another sort free; this usually succeeds, but not always. Another excellent way is to sow a few pounds of alfalfa seed with your red clover. After the clover is plowed up, sow to alfalfa, and you will probably have the field inoculated.

Alfalfa thrives best on soils that are most abundantly supplied with lime. It absolutely fails where lime is deficient. Nothing will take the place of lime, and we believe that there have been more failures throughout the eastern states owing to this deficiency than from any other cause.

Ground limestone is now manufactured in many places in the United States, and sold usually, where made, for about \$1.25 per ton. The finer it is ground, the more quickly it is available. It should be applied at the rate of about one hundred pounds per square rod, which is at the rate of eight tons per acre; although where it is inaccessible, and therefore costly, much lighter applications are used with good results, although not so lasting. Sometimes one can get crushed limestone screenings, much of it as fine as sand. This stuff is used for concrete work, walks, and ballast, and often may be bought as low as fifty cents per ton or less. When the ground limestone is not available, and this coarser material is, we advise its use. Put on more of it, and eventually every bit of it will become available. It will last for many years in the soil, giving out its beneficial influence constantly. Many farmers having ledges of limestone upon their land can well afford to grind their own limestone at home; and a machine capable of grinding a little more than a ton an hour and taking in stones 11x13 inches in size costs about \$600. These machines are very durable and the expense of operating them quite light.

When limestone rock is burned, the carbon is driven off, and caustic lime remains. Burned lime has lost about one-half its weight, so that a ton of burned lime has as much power to sweeten soils as two tons of unburned or carbonate of lime. The one difficulty with burned lime is that it has this caustic nature, and is said to destroy part of the humus of the soil. Burned lime is more easily secured, and the freight rates on it are often less than with the ground limestone. From one to two tons per acre of the caustic lime are used. It may be ground very easily after being burned, and then drilled into the soil; or it may be slaked with a little water so that it falls into a white powder, and then distributed. "Agricultural lime," often sold at absurdly high prices, is simply burned lime slaked and ground, and is in no way better than the lump that any farmer can slake at home.

The question is often asked: "Will alfalfa stop tile under-drains?" On Woodland Farm with probably eighteen miles of tile under-drains, only a few hundred yards have given trouble from being stopped with alfalfa roots. These places where trouble has occurred are where running water flows through the tile continuously from perennial springs. In no instance has the alfalfa given trouble to ordinary farm drains where the tiles become dry in summer.

(To be continued.)

RECONSTRUCTION OF IRRIGATION SYSTEM.—

A grant to a canal company of a right of way or easement for its ditches in the streets of a city is subject to the right of the city to thereafter regulate the manner of the exercise of such easement, or to change the grade of the streets in such a way as to require a corresponding change in the conduit for the delivery of water; and in exercising its right to grade its streets, the city may, if it comes necessary so to do, remove such ditches and require the reconstruction of the company's system by a pipe line beneath the surface. *City of Nampa v. Nampa & Meridian Irr. Dist.* Supreme Court of Idaho. 115 Pacific 979.

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This Federation is organized for the promotion and encouragement of the irrigation, reclamation, colonization and development of land within the United States of America. It maintains an office at 1110 First National Bank Building, 38 South Dearborn Street, where there is open to the public, free of charge, maps and publications relating to the lands of the United States. Questions relating to irrigation matters will be answered by the officers of the Federation and information given.

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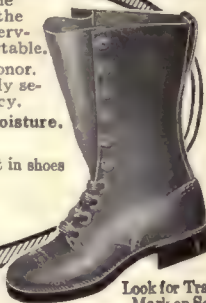
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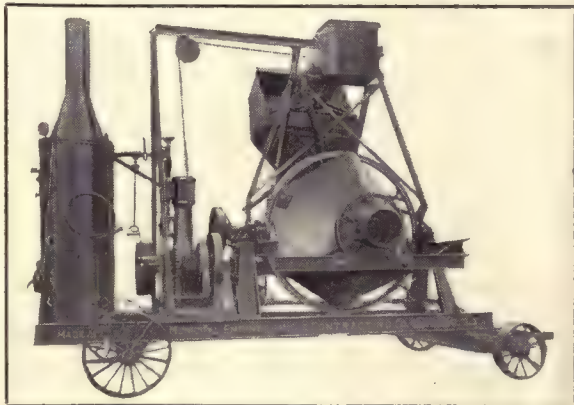
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Agents wanted in unoccupied territory

(Continued from page 68.)

lar farmer, but there is also a wide field of the bee man on these projects where everything tends toward specialization and where the farmers organize for the standardization and marketing of their crops. On nearly all the projects small tracts for the purpose may be purchased at reasonable rates. On many of them there are model towns laid out at intervals of a few miles. The business lots are grouped around a central square, and near the outer boundaries of the town sites the lots contain several acres each. These large lots, surrounded by wide areas of new agricultural lands devoted largely to the raising of alfalfa, are ideal locations for apiaries. They are sold at very reasonable rates, and afford opportunities for engaging in a business which pays large returns on the investment. The average price of bees in the West is probably about \$5 a hive. The manager of a large apiary on one of the irrigated tracts gives the average production of his hives as 76 pounds of surplus honey per annum. At ten cents per pound the returns would be \$7.60. In addition to that the increase averages 100 per cent from year to year, doubling the original investment and making a total of about 150 per cent profit each year on the original investment.

The statistician of the Reclamation Service at Washington, D. C., will furnish detailed information concerning lands irrigated by the government upon request.

DESERT LANDS.

Where final proof on a desert land entry has been rejected by the Commissioner of the General Land Office and appeal is taken to the Secretary of the Interior, accompanied by affidavits submitting new proof, which has not been considered by the Commissioner, the case will be remanded again to the Commissioner for adjudication upon the new record.

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The Primer of Hydraulics will be ready January 1, 1912. Send \$2.50 for a copy of this newest and best book on Hydraulics for plain people.

They are used exclusively on the Panama Canal. Sixty of the Panama machines are the largest batch mixers ever built, holding 64 cu. ft. each.

The Los Angeles Aqueduct (240 miles long and to cost \$30,000,000) used forty-seven Cube Mixers.

On the Michigan Central Railroad Tunnel under the Detroit River, the concrete was mixed exclusively in Cube Mixers.

Thirty-two railroads in the United States are using Cube Mixers.

The Imperial Government of Japan specifies Cube Mixers on all its concrete work.

What the Improved Cube Mixer Will Do

IN speed of charging; in speed of mixing; in speed of discharging; in uniformity of concrete; in concrete strength; in cost of operation; in cost of maintenance; in capacity of output—the Chicago Improved Cube Mixer will outclass any other type or make of mixer day in and day out, year after year. It is for these reasons that leading engineers everywhere specify that concrete on their work shall be mixed with our Improved Cube Mixer.

Our Catalogue Will Interest You—Ask for No. 12

(Continued from page 66.)

salts, and 236,000 tons of Epsom salts. The mud and silt carried in suspension by this river amount to 1,100,000 tons. Milk river at Havre, Mont., discharges annually 41,000 tons of soda. Payette river, in Idaho, discharges 46,000 tons; Salt river at Roosevelt, Ariz., discharges 288,000 tons of salt and 170,000 tons of Epsom salts; and the Rio Grande discharges 245,000 tons of lime and 368,000 tons of Glauber's salts.

The foregoing are a few of the figures of incidental interest presented by Water-Supply Paper 274 of the United States Geological Survey, entitled "Some Stream Waters of the Western United States." The work reported by this volume is, however, of higher practical importance than the above statement would indicate. It is the result of an investigation of the quality of western stream waters made for the purpose of determining their availability for use for irrigation and other purposes. For a water-supply system the quality of the water available determines its usefulness quite as much as the quantity. Some waters contain ingredients that make it impossible to use them for irrigation unless certain precautions are taken in applying them to the land and in draining them off. Certain ingredients in water make it unavailable or destructive if used in boilers and the quality of water used in a manufacturing plant may very largely determine the quality of the product of manufacture. The report just published therefore cannot fail to be of material value to the manufacturing and agricultural interests of the West; and the proper consideration of the information that it contains will prevent many costly mistakes in connection with the industrial development of that part of the country.

A copy of this report may be obtained free on application to the Director of the United States Geological Survey, Washington, D. C.

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give all the water needed for irrigation without pumping expense or bothering with an engine.

Cost little to install—nothing to operate. Raise water 30 ft. for every foot of fall. Land lying above ditches watered at little or no expense. Pump automatically day and night, winter and summer.

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If there is a stream, pond or spring within a mile, write for plans, book and trial offer, FREE.

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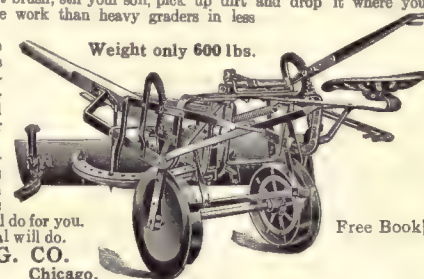
Solves Your Irrigation Problems. This light weight, all steel, one man machine will cut ditches from 24 to 36 inches deep at a cost of 2 cents a rod and grade roads, clean streets, cut brush, stir your soil, pick up dirt and drop it where you want it. Will do more work than heavy graders in less time at less cost.

One man with two or four horses operates it. It is a perfect combination of several expensive machines and will save its cost over and over again.

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Free Book!

Combination Headgate and Measuring Device

IT remained for the U. S. Irrigators' Supply Company to combine the accuracy of the Weir with the simplicity of the Miners' Inch Box, the merits of the meter with the needs of the farmer, to conform to the statutes of the different states as to the Miners' Inch and Second Foot, to take the accuracy of all measuring devices and to simplify them so the farmer can use them and know he is accurate.

Our device is accurate enough for the most exacting engineer. It meets the requirements of the law; it meets the needs of the farmer. It gives a uniform system of measurement.

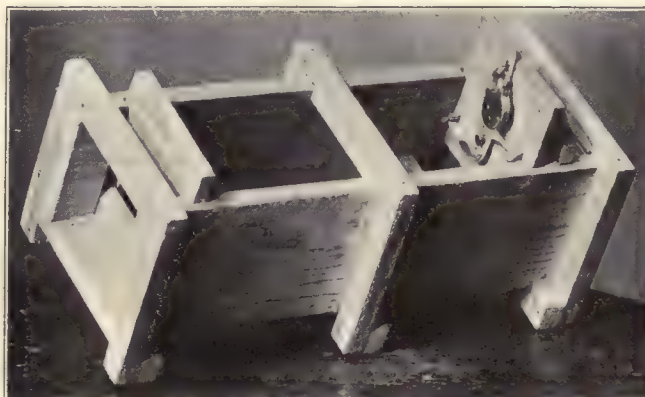
It is a headgate and it measures correctly. It is locked and no one can raise or lower it. It gives the farmer the power to shut off the water at any time he does not need it. It meets the needs of the individual, the community, or the irrigation system. It is the cheapest and best device. It is up-to-date.

It sounded the death knell of the water thief.

Its simplicity is the result of the needs of the farmer. Its accuracy is the result of the work of scientific, painstaking, competent engineers.

It is approved by Senators, Judges, Engineers, and Farmers. It is adopted by Communities, Ditch Companies and Counties, and will be adopted by all the states as the Standard of Measurement wherever Irrigation prevails. It is used by hundreds of Montana Farmers, and we have our first complaint to hear.

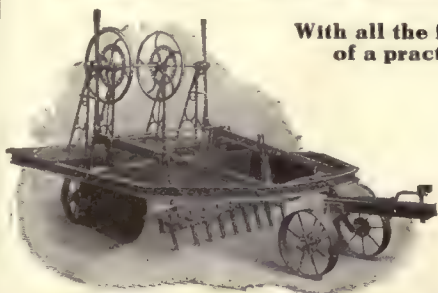
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of a practical

Grader
Ditcher
Digger
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Conveyor

Cut showing diggers and fenders attached. These can be removed and the blade set for lateral ditching in five minutes.

BLADE COMPLETELY REVERSIBLE

**WHEELS FITTED WITH FLANGED RIMS AND
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Lightest draft. No weight on horses' necks. A "snap" for teams and operator

Write Us.

THE OHIO ROAD MACHINERY CO.

Oberlin, Ohio
Box F.

(Continued from page 65.)

acres of land at the present time, but 18,000 acres opened up some time ago has been settled, and the company is now offering 15,000 more. As soon as the water system is extended irrigation will be afforded for 10,000 more acres.

WASHINGTON.

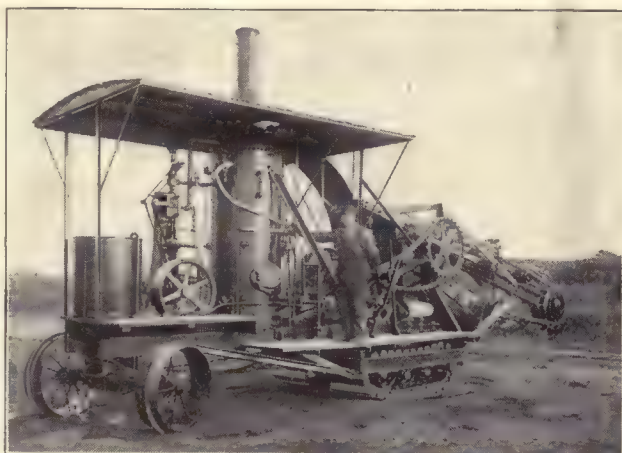
Frank P. Dalton, of North Yakima, has filed suit against the Union Gap Irrigation Company for \$1,500 damages and a permanent injunction restraining the irrigation company from allowing water to flow onto the land of the plaintiff

The Secretary of the Interior has awarded contracts for work and materials on the Mabton division of the Yakima irrigation project as follows: Albert Smith of North Yakima, trench construction, \$4,845; to Midland Engineering Company of North Yakima, flumes, etc., \$10,054.

The Dungeness Irrigation Company of Olympia has filed articles of incorporation and will undertake the reclamation of arid lands in Jefferson and Clallam counties. Dungeness, in Clallam county, is the principal place of business for the company.

The Secretary of the Interior has formally approved the transfer to the United States of the irrigation system of the Prosser Falls Land & Power Company in Benton county. The property is to be incorporated with the Sunnyside unit of the Yakima project.

The Reclamation Service is making an investigation of the feasibility of extending the Okanogan project in Washington by the addition of two units. Both of these will be irrigated by pumping. One of the units includes 1,100 acres in the present project limits known as Robinson Flat and requires a lift of approximately 180 feet. The other will take in lands in the Colville Indian reservation.



**The testimony of a contractor
who has used a ditching
machine** ought to be a good guide to the contractor who is going to buy. It should also wake up the contractor who employs manual labor to the merits of machine digging so that he may investigate and learn how he can double his profits on his present volume of work with an Austin Trench Machine.

**We quote from a letter
recently received.**

We have hundreds of similar letters.

"The two No. 00 machines which I have at work on the gas pipe line are doing splendid work. Yesterday one machine cut 1500 ft. of 5 ft. ditch in fairly hard clay in something less than ten hours. I have used one of these machines on sewer work and on tile ditching and find it well adapted for both purposes. I used it with an extension, digging 10½ feet, on sewer work and ran from five to eight hundred feet a day in soil consisting of clay top and gravel subsoil. In ditching work we had all kinds of digging, ranging between quicksand and hard pan, and found the machine equal to any kind of soil except when rocks too large for it to handle were encountered."

We make ditch-digging machinery of all kinds, suitable for every sort of work, trenches for sewer and water mains and for farm tile drainage.

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F. C. Austin Drainage Excavator Company

(25 Years' practical experience in building excavating machinery.)

RAILWAY EXCHANGE

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To effect this it will be necessary to construct a power plant on the Salmon river and transmit this power to various points from which water will be pumped into the canals from Okanogan river.

MISCELLANEOUS.

Forty thousand acres of land in Prickly Pear valley in Montana will be reclaimed by pumping water from Hauser lake. This project is being financed by Eastern capitalists. M. H. Geary, Jr., of the Missouri River Power Company of Helena, Mont., is in charge of the Western office of the company.

The first unit of the government's irrigation project which is being built in Sun River valley, Mont., known as the Fort Shaw unit, is completed.

Construction work on two large reservoirs which the Western Land and Irrigation Company of McGill, Nev., proposes to build in connection with its irrigation project in Steptoe valley, is being rapidly completed. The reservoirs are located about thirty-five miles from Ely, Nev.

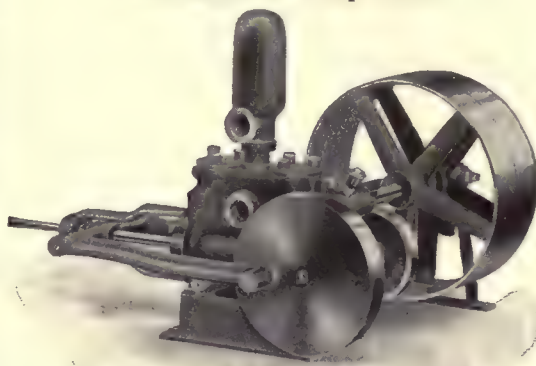
At a special meeting of the Industrial Club, held in Garden City, Kan., recently, the plan for a central power house and a pumping irrigation proposition involving 10,000 acres at an average cost per acre of \$30 was strongly indorsed. The land in question lies directly north of the town of Garden City in what is known as the shallow water empire.

H. D. Bosse of Ellinwood, Kan., will install a sub-irrigation plant in his orchard near that town. He has already purchased and installed six miles of tile, which is perforated and lets the water seep through small holes, letting the water reach the roots of the trees and not being subject to evaporation.

The Leon Valley Irrigation Company of Dallas, Tex., has purchased 2,400 acres of irrigable land in the Pecos valley and will bring it under cultivation.

BUCKEYE POWER PUMPS

For Shallow or Deep Wells



Irrigation Pumps and Cylinders a Specialty

Illustration shows our shallow well Power Pump, but we make a complete line for deep wells in a variety of sizes.

Send TODAY for Special Catalog describing the exclusive features of these pumps.

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are sprayers of quality. Winners of the gold medal in the spraying machine contest held by the National Horticultural Congress at Council Bluffs, Iowa, November 10th to 19th, 1910. Sprayers for every purpose—Hand or traction power. If you grow one or one hundred acres of fruit or field crops, you need a Hurst Sprayer.

We ship our sprayers
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Edmund T. Perkins Engineering Company

IRRIGATION AND AGRICULTURAL ENGINEERS

Investigations, Reports, Plans, Estimates and
Construction

Financial assistance procured for projects
examined and approved by this company

First National Bank Bldg., Chicago, Ill.

(Continued from page 66.)

age price was over \$2 a barrel and as late as 1903 it was \$1.24 a barrel.

Mr. Burchard remarks that measured by the capital invested the cement industry is one of the world's three great extractive industries. In capital employed it apparently far outranks the gold-mining industry of the United States, including Alaska, as well as the copper industry. Only coal and iron stand ahead of it.

The principal constituent of Portland cement is limestone, and Mr. Burchard's report summarizes the most important limestone formations in all the states. The greatest of these are found in the eastern half of the United States, where there are enormous limestone deposits. The report is accompanied by a map showing the distribution of these limestones. The areas they cover comprise many thousands of square miles. The map also shows the location of the operating cement plants in the United States.

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To sell highest grade irrigated fruit land in the country. Exceptionally attractive selling terms. This is the best paying proposition today for land men who are live wires in all sections of the country. Address ROBERT S. LEMON, General Sales Manager, Bitter Root Valley Irrigation Company, Suite 848-898 First National Bank Building, Chicago.

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ASSOCIATE WORK FOR ATTORNEYS



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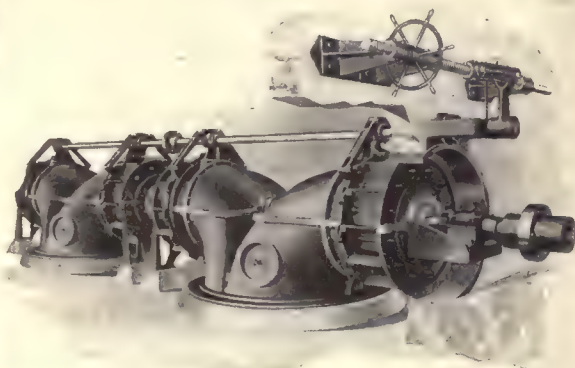
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RIDE EASY No Noise No Dust

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Perfect Passenger Service

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are installed in many of the best equipped plants, because of their simplicity of design and substantial construction.

SEND FOR CATALOG 25

The Dayton Globe Iron Works Co.
Dayton, Ohio

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(Continued from page 70.)
discouraged us had we not known that few of the longer explorations of the Geological Survey in Alaska had been regarded as practicable by traders who were most familiar with the locality."

Mr. Brooks describes a series of marches, with topographic and geologic work en route, weary days of trail chopping through dense thickets, and experiences with swollen rivers which taxed the ingenuity and hardihood of the members of the party to the utmost to get themselves and their pack animals across. Moose, wild sheep, and other game occasionally fell to the rifles of the men and served as most welcome changes in diet.

Finally, Mount McKinley and Mount Foraker, which in clear weather had been visible for most of the time, loomed large and majestic and on August 4 camp was made only 14 miles in an air line from the summit of Mount McKinley. "Here" says Mr. Brooks, "a day's delay permitted the writer to climb a spur of the mountain to snow line and to obtain some clue to its geologic structure; but satisfaction at standing on its slope 9 miles from the summit, which had never before been approached by white men, could not but be tinged with regret that there was neither time nor means for reaching a higher altitude."

The position of Mount McKinley was accurately determined, as also its altitude, 20,300 feet. Mount Foraker, some 15 miles to the south of Mount McKinley, was also located, and its altitude of 17,000 feet determined.

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Everybody knows there's money in Alfalfa if properly grown. Alfalfa growers do not seem to realize the importance of saving one crop each year for seed. Alfalfa seed is in great demand and you can have a yield of from 2 to 6 bushels per acre per year.

Write for our Alfalfa Booklet—FREE. It is written by Prof. J. M. Westgate, U. S. Dept. of Agriculture, Washington, D. C.

We had Prof. Westgate compile this booklet especially for those interested in growing Alfalfa for seed and hay. We are interested in the Alfalfa Seed Question because we are the only manufacturers of a machine built especially for hulling and cleaning Alfalfa Seed. The Booklet however, deals with Alfalfa only and contains nothing concerning our machinery. Write for it today.

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Do the work at average cost of **One Cent** per horse power hour. Immense saving by our method of "pre-heating" the fuel. Built so perfectly that repairs cost less than \$1 per year average. Every valve is vertical and will not wear on the stem or slip inside. Freezing cannot injure bed as cylinder and base are separate. Hammered steel cranks, cut gears, etc.

GUARANTEED FIVE YEARS

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1005 Oakland Avenue, Kansas City, Mo.

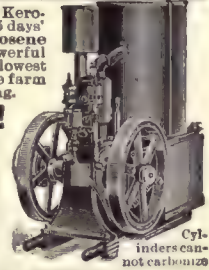


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Amazing "DETROIT"

The "DETROIT" is the only engine that handles coal oil successfully; uses alcohol, gasoline and benzine, too. Starts without cranking. Basic patent—only three moving parts—no cams—no sprockets—no gears—no valves—the utmost in simplicity, power and strength. Mounted on skids. All sizes, 2 to 20 h. p., in stock ready to ship. Complete engine tested just before crating. Comes all ready to run. Pumps, saws, threshes, churns, separates milk, grinds feed, shells corn, runs home electric-lighting plant. Prices (stripped), \$29.50 up. Sent any place on 15 days' Free Trial. Don't buy an engine till you investigate amazing, money-saving, power-saving "DETROIT." Thousands in use. Costs only postal to find out. If you are first in your neighborhood to write, we will allow you Special Extra-Low Introductory price. Write! Detroit Engine Works, 371 Bellevue Ave., Detroit, Mich.


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We positively give to BOYS and GIRLS a BEAUTIFUL American-made stem-wind, stem-set watch with handsomely designed case, proper size. GUARANTEED 5 YRS. Also dainty ring, set with three sparkling stones, for selling 20 jewelry articles at 10c each. Order jewelry today. When sold send \$2 and we will send watch, ring and chain. We guarantee Satisfaction. Dial Watch Co., Dept. 7, Chicago

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Farmers and Shop Owners, Stop sweating! A few dollars gets this grand little work engine, complete and ready to run Cream Separators, Corn Shredders, Grist Mills, Feed Mills, Dynamos, Printing Presses, etc., etc. Gives a lifetime of steady service! All Sizes: 2 to 20 h. p. No cracking! No clogs! No gears! Only 3 moving parts. Finest construction. Thousands in use. Guaranteed 5 years. Write for Special Introductory Proposition. **DETROIT MOTOR CAR SUPPLY CO., Catalog 102 Detroit, Mich.**



Soil Salvation

25 years practical experience back of Bostrom's book entitled "Soil Salvation." After studying it, you will know how to make useless land grow as big crops as the best, by DITCHING, TILE DRAINING, TERRACING or IRRIGATING. This book is FREE to interested land owners who write for it—it fully explains the use of

The Bostrom Improved \$15 FARM LEVEL With Telescope

A perfectly SIMPLE, ACCURATE and DURABLE outfit which includes Level, TELESCOPE with magnifying lenses enabling you to read target a quarter of a mile or more away—also Tripod, Graduated Rod, Target, Plumb Bob and full instructions. Is used and indorsed from the Atlantic to the Pacific for all sorts of farm leveling.

If not sold in your town, will ship direct on receipt of price, \$15—or will ship C. O. D., subject to examination. Money back if not satisfied AFTER ACTUAL FIELD TRIAL.

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119 Madison Ave., Atlanta, Ga.



As they pressed inland from Mount McKinley, Mr. Brooks states, August 24 was marked by an encounter with a white man and a band of Indians, "the first human beings we had seen in nearly three months," and a few days later the party emerged from the forest on the south bank of the Tanana at the small native settlement of Tortella, or Nenana. "To the natives the arrival of white men from the mountains seemed little short of miraculous." The great hazards of the trip had now been overcome, yet the record states that in covering an ensuing 30 miles the difficulties of travel occupied the energies of the entire party for eight days, as streams had to be bridged, forded and rafted, and even corduroy trails built. Within six days five different bridges were constructed and six rivers were rafted. On the 15th of September the party reached Rampart and the next morning boarded a river steamer bound for St. Michael.

SAND-LIME BRICK.

The sand-lime brick industry has developed rapidly in the United States. It began in 1901 at Michigan City, Ind., with one plant producing only a few thousand bricks, which was followed shortly by a plant at Wilmington, N. C. In 1903 there were sixteen plants in operation, which marketed a product valued at \$155,040. From this small beginning the number of operating plants and the value of the product increased steadily until 1907, when 94 operating plants reported an output valued at \$1,225,769. These figures are the highest yet recorded in the industry. In common with other industries, the manufacture of sand-lime brick fell off considerably in 1908. In 1909, however, there was a small increase, and 1910 bids fair to exceed the record of 1907. This industry is now firmly established and will probably show steady growth.

This industry was started in the nineties in Germany where there are now 280 plants in operation. In places where brick clay is not found and where sand and lime can be easily procured these bricks can be made cheaper than ordinary clay bricks. In 1902 the German government purchased nine million bricks of this kind for constructing army buildings, at a saving of \$20,000 over the cost of clay bricks.

The United States Geological Survey has just published a report by Jefferson Middleton on the production of sand-lime brick in 1909, an advance chapter from the Survey's volume, "Mineral Resources of the United States, Calendar Year 1909." The pamphlet can be obtained free by applying to the Director of the Survey at Washington, D. C.

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Look for the RED BALL sign. 45,000 dealers in all parts of the country sell "BALL-BAND." Many of these dealers display the RED BALL sign in their windows or in their stores as a guide to the increasing number who are asking for this famous footwear.

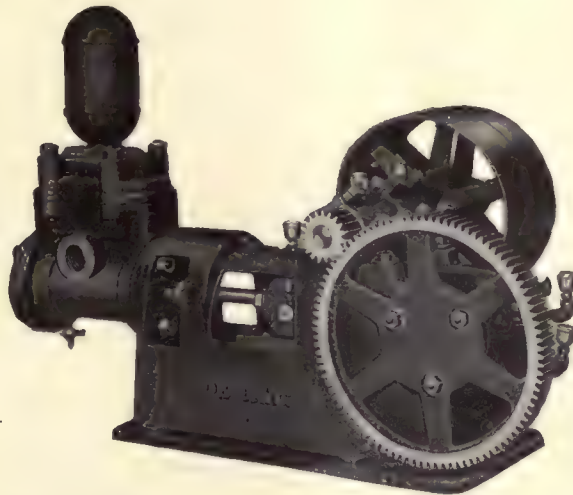
But if you do not see the sign you are sure to find the trade-mark on every article of "BALL-BAND." Insist on it. If your dealer cannot supply you, write us and we will see that you are fitted.

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ands of gallons of water every day. The valve seats are brass, and the valves are accessible without disturbing the pipe connections. They are made in a variety of sizes.

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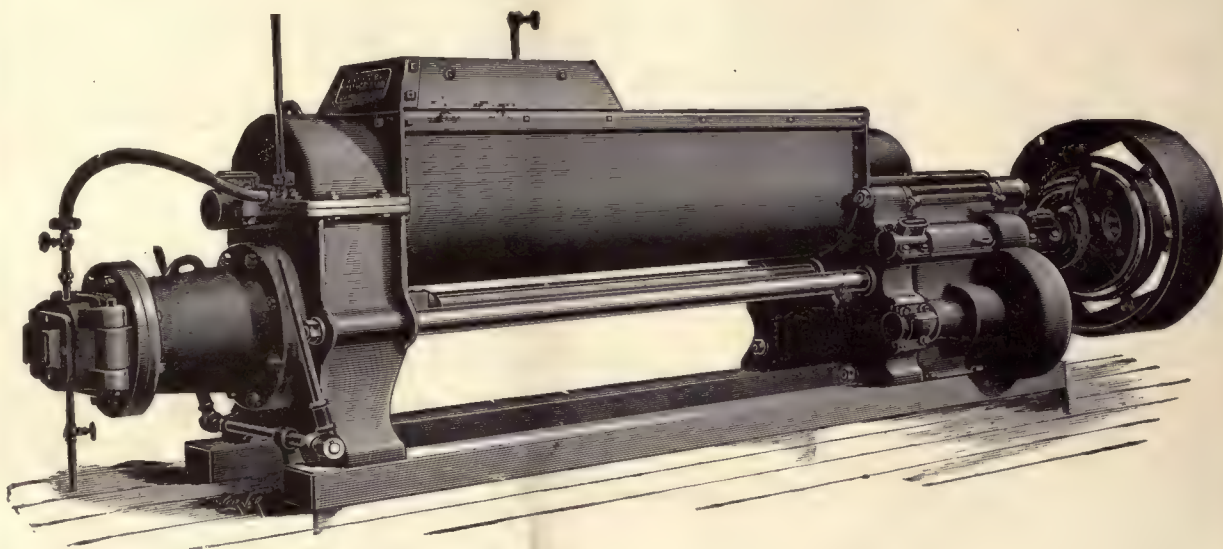
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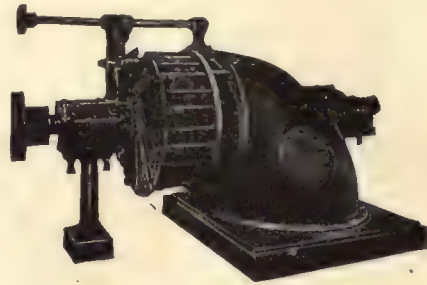
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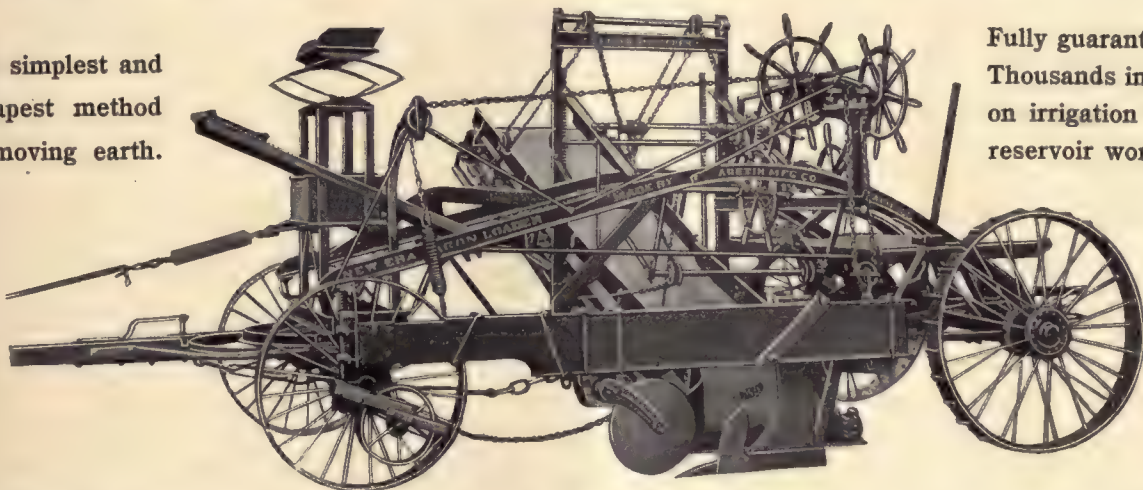
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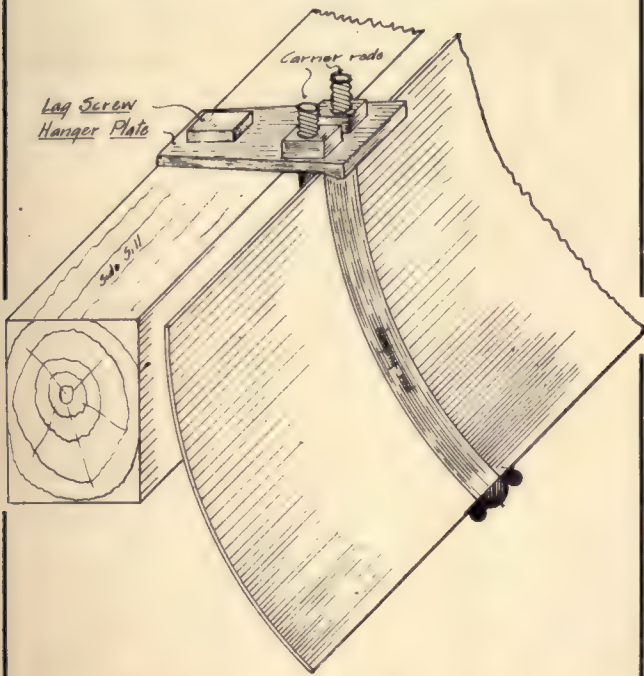
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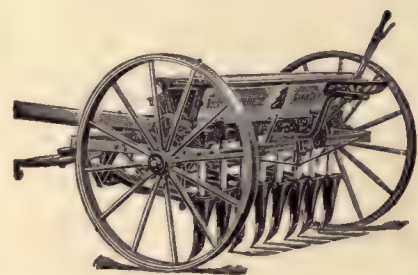
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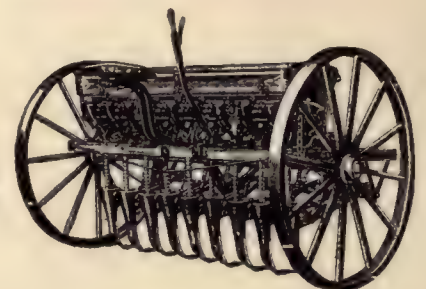
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VOL. XXVII

CHICAGO, JANUARY, 1912.

No. 3

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old and is the pioneer publication of its class in the world.

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The Prospects Good For 1912.

There has been a heavy fall of snow all
through the Rocky Mountains so far
this winter and, judging from previous
experience, the remainder of the winter
months will add to the store of solidified
water until there is a plenteous supply
store up in the mountain fastnesses of the Rocky ranges
ready to feed the creeks, brooks and rivers as they travel
on the road toward the sea.

It is a beautiful and perfect arrangement whereby the
Creator has provided for the conservation of the activ-
ities of the world, and particularly for those relating to
the growing and harvesting of the various crops which
form a basis for the sustenance of organic life. The many
uses performed by the solar energy are of the utmost
importance—in fact, indispensable in the economy of
nature.

The very fact of the bounteous snowfalls referred to
above are the direct results of the energy of the sun,
whose rays have lifted the water from the oceans or
lakes and carried them on the wings of air current to
the high Sierras, where the water vapors condense and
cover the tops and sides of the mountains with a heavy
mantle of snow. It is a wonderful process in the econ-
omy of nature to have the heat of the sun draw from the
salty ocean virgin pure water in tremendous quantities
and deposit it in altitudes up to 14,000 feet above sea level,
to make it available for the use of living nature on its
way back to the sea. Thus the young mountain stream
in the higher altitudes assists the miner in washing gold

and furnishes the game and wild animals refreshing drink; it waters the meadows along its course and feeds the vegetation until it reaches the realm of the irrigator, where it is harnessed to water growing crops, to drive wheels for the production of electricity, and thus provide not only the most essential plant food for the crops, but also home comforts for the inhabitants. Thus the river, on its way back to the ocean, performs such a multitude of uses that it would be difficult to enumerate all of them. Everywhere the beneficent fluid is required; maybe for irrigation, municipal water supply or a supply for industrial works; everywhere the toiling river distributes its blessings, using up gradually the potential energy imparted to it when raised by the sun to the top of the mountain, and finally, when arriving at its journey's end, it throws its sluggish and dirt-laden waters back into the ocean.

This is the purification reservoir, for this tremendous basin forms at once the grave and the cradle of all the rivers, since the regenerative power of the sun is constantly raising new rivers out of the oceans and planting them on the higher altitudes, while the rivers discharge their tired fluids ready for future regeneration and work.

Thus the rotation of beneficent activities keeps up for ages and ages; while the sun retains its vivifying power, nature responds and the laws which a wise Creator impressed into the material world will continue to bless man so long as he is willing to co-operate with them and use his brain and brawn to apply them to his uses in the proper manner.

Thus as knowledge and intelligence increase from day to day the problems of the soil and irrigation become clearer and easier of solution, and every year brings us nearer to the goal when we understand the laws of nature fully enough to provide health, happiness and wealth to all who will make efforts in this direction.

Spray Irrigation Versus Ditches.

Irrigators in many parts of the country are beginning to understand the advantages of spraying over irrigation by ditches. This is particularly important where water is either scarce or where it may be used for irrigating additional

lands. The system is, of course, more expensive, as the water has to be carried in pipes under pressure with spraying attachments to vertical pipes which are inserted in the mains at regular intervals.

Thus a spray system of irrigation resembles somewhat the water system of towns and cities, and is, in fact, used in the dwellings and barns for such purposes, supplying all the water for domestic purposes, as well as the barns.

The principal advantage of the spray irrigation is economy in the use of water, as there are no losses by seepage or evaporation and the spraying prevents the water from percolating the soil before it has had an opportunity to come in contact with the roots of the vegetation.

It is especially recommended that this system will work well in apple orchards where mains are laid between the rows of the trees underground and a sprinkling pipe is tapped into the main at certain intervals.

It is claimed in certain cases where the water is obtained from wells having a temperature of 60° F. this sprinkling can be used successfully to prevent freezing of the blossoms, the difference in temperature being suf-

ficient to keep the temperature of the air in the sprayed section above the freezing temperature.

Any successful method of preventing the freezing of blossoms will be hailed with delight by the fruit growers in districts where trouble has been encountered along these lines.

The New California Irrigation Bond Law.

The Legislature of the State of California has quite recently passed a new law commonly termed the Griffin act, which provides means for the making of irrigation bonds, legal investments for banking, banking associations, trust companies, insurance companies and for state school funds.

The provisions of the act are briefly these: Whenever the board of directors of any irrigation district declare by resolution that they deem it advisable to issue bonds for purposes of improvement, they shall forward such decision to the Irrigation Bond Commission of the State, which will investigate into the affairs of such district. If this commission finds that the project is feasible then the bonds of the district are declared available for legal investment purposes.

The law provides further that not more than 60 per cent of the bonds be issued of the aggregate value of the lands and water rights of the district and that all bonds issued in accordance to this law must be recorded in the office of the state comptroller.

The foregoing features apply to new districts, but provision is also made in the Griffin act permitting existing districts to apply to the commission for an investigation of any or all past bond issues. A favorable report will act as a certificate of character and will make their bonds legal investments.

The bonds issued by older districts, which are now actually engaged in the distribution of water to all or some portions of their territory and have not defaulted in the payment of the interest upon such bonds, are considered legal investments without any investigation by the commission. This Irrigation Bond Commission consists of the state engineer, state comptroller and attorney general.

The new law is intended to make it easier to obtain money for the development of promising irrigation projects, but at the same time it provides also safeguards for the investor, and the 60 per cent limit should be sufficient to guarantee the value of the bonds.

Interstate Water Question Discussed.

Quite recently a decision was rendered by District Judge Carl A. Davis of Idaho ruling upon the question of diverting an Idaho stream for use in Montana and giving first appropriators in Montana the preference. The principal

facts in the case are briefly these: Montana irrigators secured a permit from the Idaho state engineer to appropriate eight second feet of the waters of Bear Creek in Idaho county, state of Idaho, to irrigate 880 acres of land located in Ravalli county, Montana; the Montana irrigators spent 5,000 dollars in construction, and when the diversion works were completed notified the state engineer of Idaho that they were prepared to offer proof of the completion of the work and asked the engineer to order the publication of the proof as required by law, which he refused to do.

In the opinion of Judge Davis the following points are brought out:

"It is clearly established by the highest authority that in the absence of statutes to the contrary, where a stream flows from one state into another, prior appropriators on the stream below the dividing line have a superior right to that of later appropriations within the state where the water is first available. This would seem to establish the principle that water, which is originally the natural resource of one state, may be dedicated to a beneficial use within another. And while the cases that may be cited on this point refer to water of streams that would naturally flow into the second state, if left unappropriated within the state of their source, the principle involved is practically the same, for the state where the water that becomes available doubtless has a legal right to control the disposition of the entire flow of even an interstate stream while within its boundaries under the principle of priority of appropriation adopted in Idaho and other western states.

"The old common law doctrine of riparian rights was to the effect that the water of streams should flow in their regular channel for the use of those along the banks; but the principle that priority of appropriation shall govern the use of water necessary for irrigation rests on the theory that the water is more valuable applied to a beneficial use of lands to which it may be diverted than it would be flowing down a natural channel, and that the first person to so divert such water should have the superior right thereto."

It is not our intention to find fault with this decision, as, no doubt in this special case, it was equitable and just; yet it is necessary to discuss the proposition, as it is a very important subject which no doubt should receive attention at the hand of the legislatures in the various states. The error was undoubtedly made by the state engineer of Idaho in granting an unrestricted permit to residents in Montana to use the waters of a creek flowing from Idaho into Montana. If this principle be made applicable to an extreme case for instance, then some one in Texas might have been first to appropriate the waters of the Rio Grande and thus cut off the states of Colorado and New Mexico from the use of such water.

It stands to reason that it would be obviously wrong to deprive anyone living along a water course of the use of water, for it is evidently the right of every living creature to make use of the necessities of life nearest to hand; thus the people living along the course of the Rio Grande in Colorado should have a prior right to the waters of the river over those living along the river in New Mexico and those in New Mexico should have prior rights to the Texas people, regardless of priority of filing. The fact that all rivers are formed and kept flowing by the rain and other precipitation along their courses through the various drainage basins indicates that the very water intended for the settlers along such water courses is carried away by the river, and it would seem an injustice to deprive such residents of the use of such waters just because some one lower down has made a prior application.

Scientific Principles Must Be Observed.

ods based upon those who have not followed the development of new

The developments which have taken place during recent years along lines of agriculture are plainly showing that the old ways which have been practiced for centuries are no longer satisfactory and must make room to modern methods based upon scientific principles and research. To

procedures in the field of agriculture the progress made is simply amazing and astounding. It cannot be denied that perhaps the greatest force acting in this direction today consists in the work of the many agricultural colleges and experiment stations as an adjunct to the Department of Agriculture of our national government. Here it is where the present-day problems of the farmer receive thorough and scientific treatment and where the results are tabulated and published, thus making them available for the whole community.

With the tremendous strides made forward during the last decade in the way of irrigating the arid lands of the west many problems were encountered which have bothered the brains of some of the best talent in the United States, but they were solved satisfactorily, as is proven by the many successful irrigation projects completed now and in operation.

There were, however, some irrigation projects put under way without sufficient preliminary investigation and, as a result, some of them have failed. The principal reason responsible for such failures has been insufficient investigation as to amount of water available, or quality of land and water. In many cases the supply of water has proven deficient and in other cases the soil has proven absolutely worthless.

These failures point the way to the remedies. No irrigation project should be authorized unless there has been a thorough investigation either by the government or competent authority as to the amount and quality of the water available, and next there ought to be a thorough investigation regarding the quality of the soil which should be made by competent agronomists of the various experiment stations.

The new law in California, referred to elsewhere in this issue, provides for the first part of these requirements, as the state commission must investigate the sufficiency of the water before a new district can be organized under the law.

There will be less difficulty in financing worthy projects when investors have the assurance from competent authority that the essentials of success have been determined, namely, a sufficient quantity of water, a good quality of water and a rich soil. These three factors must be determined by technically trained men. Other factors, such as markets, climatic conditions, etc., are easily observed by the average citizen.

Thoughts That Come and Go.

farmers and settlers.

The article on "Alfalfa Culture in America" has been abstracted from the International Harvester Company Bulletin "For Better Crops." It would seem that this company is doing much good work in spreading useful information among

* * *

"On the Roof of the World" is a very interesting article by Mr. W. D. Boyce, giving a splendid description of a trip through South America. It is richly illustrated and should prove a treat to everyone who reads it.

* * *

The "Primer of Hydraulics" is now passing through the finishing touches and will be ready for delivery about February 1 next. Send in your orders now, as they will be filled in the order they are received. The price of the book, cloth bound, is \$2.50 net, post paid.

ALFALFA CULTURE IN AMERICA*

By Joseph E. Wing

Expert Agriculturist, Mechanicsburg, Ohio

Good soils are frequently stored with weed seeds; yet a thorough cultivation of the ground the year preceding the sowing of alfalfa will accomplish much. Ordinary weed seeds are pretty well destroyed by the mower running over the ground two or three times the first season. Canada thistles are said to be eradicated by the growing of alfalfa; and many other serious pests, including *convolvulus arvensis* variously styled bindweed, wild morning glory, or wild pea vine.

Sometimes a little sweet clover (*melilotus*) is unavoidably present in alfalfa seed. This need give no concern, since the natural mowings given the alfalfa will eradicate it in two years. There are weeds, however, that will get the better of alfalfa, and that right speedily. One of the worst is dodder. Not many farmers know dodder when they see it. It is a parasitic vine, having an almost leafless, yellow stem as large as a small twine string which runs through the alfalfa, twining around the stems, sending little rootlets in to suck the juice of the plant. Dodder begins its life from a seed dropped to the earth when the alfalfa is sown; but after having had a brief experience with its roots in the soil, it leaves the earth and roots only in the growing alfalfa, which it binds together in a death grip, making a dense tangle of yellow vines and slowly dying alfalfa plants.

Farmers cannot afford to treat dodder as they would any other weed. It is so deadly that it must be stamped out immediately, or it will become a very serious pest, and the methods used to exterminate other weeds will not answer for this one. If there are only occasional small patches to be found, mow the alfalfa in these patches before the dodder begins to bloom; then in a few days, scatter straw over the infested areas, and burn it. This may kill the alfalfa plants, but it will probably kill the dodder also. If your field is badly infested, there is nothing to do but to plow it up, and plant it to corn or some cultivated crop for one or two years.

Dodder infests clover just as frequently as it does alfalfa, and it is just as dangerous in the clover as it is in the alfalfa. Farmers should take great pains to prevent this pest from becoming established in their land, and should send samples of their seed to their experiment stations for analysis before seeding.

We cannot recommend seeding alfalfa in corn at the last cultivation, as many wish to do, because the corn nearly always shades the alfalfa so much that it will not thrive until after the corn is cut; also the corn takes practically all of the moisture from the soil, causing the alfalfa to suffer from drouth; and it usually happens that we have most of the dry weather between the time of the last cultivation of corn and fall, so that all three of these causes will operate against the alfalfa. We have seen many splendid successes from this method, and many failures. We think the chances of success by this method to be about equal to the chances of failure.

While it is true that alfalfa may be grown by devoted enthusiasts anywhere, yet it has affinity for certain types of soils, and is most easily grown thereon. These soils are deep, pervious to air and water, well stored with mineral elements, and somewhat alkaline in their nature. Thus alfalfa revels in the arid west, when water is supplied, because there has never been any leaching of mineral fertility, and the land is very rich in potash, phosphorus and lime. This alkalinity favors the growth and development of the bacteria that grow upon the alfalfa rootlets and makes the plants thrive. In the more eastern sections, along the Missouri river, there are great areas of a peculiar whitish soil called the Loess

deposits. These soils are the result of wind deposit, made many centuries ago when the land was desert. On these very deep and fairly fertile Loess soils alfalfa revels, its roots penetrating to very great depths, sometimes as far as thirty feet.

Yet farther to the eastward are the prairies of Iowa and Illinois, black with stored humus and rich in plant food. On these prairies alfalfa does not naturally succeed very well. This is owing in part to a lack of drainage; in some instances, through the decay of too much vegetable matter, there is acidity in these black soils. In many other cases there is some difficulty in establishing bacterial energy, and the reason for this is unknown. However, the remedy has been found to be applications of barnyard manure, which works like magic on these black prairie soils, and when coupled with the underdraining, where it is needed, alfalfa is found to grow with remarkable vigor and profit on the black corn soils of Iowa and Illinois. The reader, if he dwells in this land, should consult the bulletins of the Iowa and Illinois experiment stations for help to make his alfalfa surely grow.

It is more difficult to grow alfalfa on some soils than on others, and on some of them it is not wise to make the attempt. First, any soil that is not more than two and one-half feet above the water line is too shallow for continual alfalfa growth. It needs a depth of at least three feet to water, and if the distance is even greater all the better. In laying tile underdrains for a foundation to an alfalfa field, seek, then, to get the level of the water line down at least three or four feet.

On peaty soils with little clay or sound earth within them, it is not often that alfalfa will thrive. There are some exceptions to this rule, though they are not well understood.

On nearly barren sands it is doubtful if it is worth while trying to establish alfalfa fields. They must be continually fed in order to produce this forage, so rich in mineral elements, and it must be remembered that these mineral elements must come from the soil.

While the most luxuriant growth of alfalfa is usually from a porous soil, a loam or gravelly alluvium, yet clays drained and stored with vegetable matter are producing some of the best growths of alfalfa in the United States. This is especially true of strong, tough limestone clays that, when in their natural state, hold water "like a jug," but when underdrained and well manured become more open and pervious to both air and moisture. On such clays alfalfa revels, and when plowed up and other crops are planted on the land, it is astonishing to see with what vigor they grow, revealing plainly the very great benefit that the alfalfa has been to the soil, both by adding nitrogen through the decay of its leaves and roots, and by bringing up mineral matters from the sub-soil, and by decaying and leaving air and water passages through the clay, always before too dense to permit these helpful agents to work their will. And when alfalfa is sown again upon these clays after one or two years of grain or hoed crops, manure being scattered over the land in the interval, it is found that the alfalfa responds wonderfully and yields better than it did from its first seeding.

What, briefly, are the advantages of the alfalfa plant over other forage crops? First, that it roots so deep in the soil. It is safe to say that alfalfa roots penetrate as deep as there is any soil. If the soil is three feet deep, the roots will penetrate three feet. If the soil is ten feet deep, the roots will go down ten feet. And if the soil is thirty feet deep, the roots will go down thirty feet. Thus the whole soil is utilized.

Next, remember that the plant uses the whole of the growing season, and it is the one crop that the farmer grows that does this. It is very hardy and does not much mind cold. As soon in spring as the sun has slightly warmed the earth the alfalfa is up and is growing. It does not mind light frosts, but keeps right on growing. Soon after the corn is planted the alfalfa is ready to cut—by the first of June in most of the region of the corn belt, earlier in the South, and not much later anywhere. Thus the soil has yielded one crop almost before the corn has begun to take hold at all.

*Abstract of the I. H. C. Service Bulletin "For Better Crops." Continued from December issue.

Next, consider what happens when you cut off that first cutting. It should be taken away as soon as little buds appear on the lower part of the stems, showing that a new growth is ready to start up. At this time the plant will be partly in bloom and the leaves dropping from the larger stems. Then is the time to cut it down and make it into hay. The hay making must proceed rapidly for soon after this first crop is laid low these buds start into action, and in about fifteen minutes after the mower has passed over the field there is a second crop under way. This makes it needful to get the crop off the field promptly and let the next one come on. In thirty days from the time it is cut there stands a second crop ready for the mower. And after that in



Stacking Alfalfa.

thirty-five or forty days there is yet a third crop ready. And if it is taken off on time there is the fourth cutting. Much of the yield of these later cuttings depends of course upon the presence of moisture in the soil, but it is sure that the alfalfa will use all of the moisture from rainfall, and if irrigation is possible it will use a very large amount of irrigation water. Thus it uses to the best advantage all of the soil, all of the season from early spring till late fall, and all of the soil moisture. Of no other crop can this be said.

The best of all is that the forage that the alfalfa plant produces is the richest and most palatable that the farmer can grow. The alfalfa plant, cut at the right time, and rightly cured, is very rich in protein. What is protein? It is what makes the red flesh and red blood of the animal. It is what makes nerve and brain and vital process. Alfalfa is rich in bone. It is the best feed for the baby on the farm, for the baby colt, the baby calf, the baby lamb, pig, and chick. It is good for the baby because the baby must have protein to build his little body. And as it is best for the baby so it is best for the baby's mother. It makes her full of milk and restores her tissues. It builds the unborn young within her, and after its birth it fills her with milk to make the baby grow.

There is no one thing so good as alfalfa for the working horse. It builds his wasting muscles, it keeps him strong and hearty. He needs much less grain when he can have alfalfa hay. And he is fuller of life and spirit than when fed upon any other day. It is necessary to remember only that this hay should be fairly mature when it is cut, and well cured so that it shall not be mouldy or musty. There ought to be no dust on alfalfa hay. There are no hairs upon alfalfa stems and leaves as there are no clover leaves; therefore alfalfa hay has no tendency to bestow "heaves" upon horses. For old and hard worked horses in thin flesh alfalfa has great restorative powers. For driving horses it should be fed in moderate amounts, else it will make them fat and soft. Even working teams may be fed too large amounts of alfalfa hay. It should be steadily borne in mind that early cut and well cured alfalfa hay is nearly as rich, pound for pound, as wheat bran, so that to feed too great an amount of it is not merely wasteful, but puts an undue strain upon the excretory organs to eliminate the unnecessary food substances from the tissues. The over feeding of alfalfa hay to horses has in some lo-

calities caused the use of it to become unpopular, and to raise an outcry against it. To offset that it may be said that the writer has fed no other hay to his horses, both working teams and driving horses with mares and foals, for many years, and has yet to observe the first instance of evil result, save that the driving horses when not used regularly become soft and easily sweated.

There is nothing else so good for the mare, while she is carrying her unborn colt, as to run on an alfalfa pasture, and eat alfalfa hay in winter. Her colt comes strong and well developed, and after it has come she is full of milk for it. Then if she is in the alfalfa meadow the colt early learns to nip the delicious herbage, and thus takes in additional nourishment at the time when he is best able to make use of it. It makes his bones grow and covers them with good, firm muscle, it hastens his development greatly, it adds to his beauty, and spirit, and usefulness. The best thoroughbreds in the United States often come from the alfalfa meadows of California, and the breeders of race horses in Kentucky are beginning to add alfalfa to the bill of fare of their petted darlings. The great Percherons of France eat alfalfa with the bloom on it when they are lusty foals in their native land. The horse breeder wherever he is should at all times endeavor to call to his aid this crop that is, par excellence, the one best suited to his use. While there is some danger in grazing alfalfa with sheep or cows, there is none whatever in grazing it with horses, and thus not only the best but the cheapest possible development may be secured.

Calves grown on alfalfa develop rapidly and are ready to become mothers earlier than when developed on other foods. Pregnant cows fed alfalfa come in strong and well nourished, with full udders. Milking cows fed alfalfa hay as part of their ration give milk as with no other possible combination. Not to go into figures or tables of percentages, suffice it to say that alfalfa leaves are a little richer in protein than wheat bran, that alfalfa stems, cut early and nicely cured, are nearly as digestible as wheat bran, and nearly as palatable. Thus alfalfa may well take the place of a large part of the grain ration, and may be made to form nearly the whole of the needed protein. Thus not only is the ration very greatly cheapened, but the animals give far greater returns than when they do not have alfalfa hay. On most farms in the corn belt there is a decided scarcity of foods rich in protein. Corn itself is deficient, and enough corn can not be fed to cows to make them give their greatest amount of milk; whereas if the attempt is made, disaster results because the excess of fat forming food consumed leads to disorders of digestion or makes the cow herself too fat to be long a profitable dairy animal. Furthermore, the corn fodder and stover, the timothy hay and blue grass, the oat straw, sorghum, silage, nearly the whole list of common farm crops that can be grown



Alfalfa in the Stack.

for the dairy, are deficient in protein, so that alfalfa has for the dairy farmer a very great value, coming as it does to balance up these other more fattening and heat-making provenders. This is not mere theory, but a fact most abundantly proven by experience in the west, in the middle states and later in the heart of the best dairying section, through New York, Pennsylvania, and New England, where some of the farmers are producing their own alfalfa, and others are securing it from their more fortunate brothers of the west. The writer has himself sent alfalfa hay to a gentleman milking one of the best herds of Guernseys in America, animals fed as well as science and skill could devise, and had word afterward that the addition of alfalfa hay to their ration made an increase in milk yield of twenty per cent!

With good alfalfa hay and good sweet corn silage, made from corn that has been allowed to mature well before being harvested, the cheapest and best milk yields



Harvesting Alfalfa.

are secured. With this ration there is indeed very little need of any other grain. That great dairy authority, ex-Governor Hoard, has found in practice that with this combination, and as little as four or five pounds daily of grain, not only has he had the maximum returns in milk and cream, but he has seen the dairy herd maintained in remarkable health and vigor. It is time the farmer should break away from the bonds that bind him to the miller and the dealer in food supplies, and learn to produce on his own farm nearly all that his animals need, including that most precious and costly thing of all, the protein content of his animals' ration.

With lambs selling for \$7.00 to \$8.00 per head, and wool soaring, men begin to ask what sort of foods best agree with sheep. The answer is, that if there is one thing that alfalfa is especially suited to, it is to the flock. Sheep love alfalfa above all other forage, and for a good reason. It is the one thing best suited to their needs. They, more than other animals, need a ration rich in protein. The growing lamb needs it to build his muscles, blood, brain, nerves, and bone. The pregnant or nursing ewe needs it to replenish her system fast drained by the demands of her offspring. The ram needs it to keep up his vigor. The wool-bearing sheep, and all breeds bear some wool, need alfalfa because it has in it the peculiar elements that make for growth of good, healthy, strong-fibered wool. And thus all sheep crave and love alfalfa hay. Think for a moment what it means for an animal to like a food. Liking in the animal world is not whim or caprice. Man is the one animal, save a worm, that chews tobacco—the only animal that drinks whisky. All animals crave things that are good for them. Why do they hunger for fitting foods? Because the very cells of their bodies are calling to be built, and thus instinct tells them that tough grasses nourish feebly if at all, that tender, rich alfalfa leaves and stems have in them substances that when assimilated go directly to build the eager body cells, to reinforce the muscles and strengthen the bones and link together the nerves. It is a fact that sheep once accustomed to a diet of alfalfa will scorn prairie hay and turn from good red clover; they seek that which nourishes best and digests most easily, therefore that tastes best to them.

For fattening lambs born on the great ranges and kept there till weaning time in the fall, nothing can take the place of alfalfa hay, if the greatest facility coupled with the largest profits are sought. The lamb feeding business has grown to magnificent proportions in Colorado, where the abundant streams coursing down from the giant snow-capped Rockies spread their life-giving waters over the fertile plains. There alfalfa is at its best estate, and nothing else is quite so profitable, saving perhaps the crops that naturally follow on alfalfa sod—sugar beets, melons, or truck. Enormous amounts of alfalfa hay are stacked up on these plains where the long, dry summers favor hay making operations very greatly, and when winter comes the lambs are bought and placed in feed lots, and fed till spring on alfalfa hay with a little Nebraska or Kansas corn or native barley or wheat. These lambs often come from the ranges half starved, having perhaps endured long drives and been held in corrals and shipping pens until they are little more than bone strung on end, but after they have eaten alfalfa



Baled Alfalfa.

hay for a time they become strong once more and ready to make good use of corn.

What has been said of the mare and of the ewe applies as well to the beef cow. If she has a sufficiency of alfalfa in winter she needs no grain at all. After her calf comes she may have a little grain, and she and the calf, all the alfalfa they care to take. Her calf should be developed largely on alfalfa. It may eat alfalfa hay every day of its life, may be soiled with alfalfa during the growing season, may possibly be grazed on alfalfa pasture; though by far the better way is to cut the alfalfa and bring it to the calf. By this manner of feeding good flesh is produced and stature assured. It is too common among breeders of beef cattle in the corn belt to confine their animals to rations composed mainly of corn and grass, neither having in them enough protein, thus there is a steady loss in size, in "scale," the animals soon become fat, undersized, "bunty" and "bunchy." The difficulty is that you have been asking impossibilities of the animal, asking it to make bricks without straw, or to build without bricks at all. Therefore breeders of pedigreed cattle find it necessary to have frequent recourse to Canadian and English herds to maintain the character of their own. In these other lands less corn and more clover and other foods rich in protein are fed than in our own. There is blood in a turnip. There is blood and form and breeding in alfalfa, a plant that gives character to whatever it becomes. Therefore, let the breeder of beef cattle see to it that alfalfa is one of his chief reliances.

Fattening cattle might be thought to be an exception to the rule heretofore insisted upon; they are desired to be fattened as rapidly as possible, why, therefore, need they be fed any foods rich in protein? Why not feed them in the old-fashioned way with corn alone, to quickly cover their ribs, and then let them go forward to market?

The theory sounds well, but does not work well in practice. These animals find waste going on in their own systems. Digestive processes require muscular action, and there is need to repair muscular tissue. Nerve force is to be maintained. Then, after all, when these animals come to the feed lot they seldom have an adequate frame of lean tissue on which to build the fat. Moreover, the modern trade demands lean flesh intermixed with fat, not fat laid on in masses. And, finally, digestion goes on better when there is fed a variety of foods containing both fat and muscle builders. So theory backs up practice, and that tells always that steers fatten more quickly, more cheaply, and better, when they have all the alfalfa hay that they want in connection with their corn. It is astonishing how much the cost of fattening these cattle may be reduced if they are bought young and fed plentifully on good alfalfa hay, and only moderately with corn. And when this beef goes to the killer he finds it by far the most profitable. There is no doubt of the great place that alfalfa should fill in the cattle feeders' business. The younger the cattle, the truer they are "babies," and the better it pays to feed them alfalfa hay.

The problem of maintaining brood sows in complete health in winter time is a serious one in the corn belt. They are voracious and must be fed. If fed sufficient corn to satisfy them they become too fat and have weak litters of pigs, or so unwieldy that they destroy their offspring through their very great clumsiness. If they are deprived of sufficient corn to do this and given no other

food, they do not keep in health, since it is nature's way to have the stomach and digestive tracts of the sow distended with bulky food. Therefore unless this is done there is set up within her an unnatural craving that ends in causing her to eat her pigs at farrowing time. Now if she is fed a liberal allowance of alfalfa hay she finds in it nearly all the nourishment that she needs, she finds her alimentary canal distended comfortably, she is satisfied with same, and she brings into the world a fine litter of pigs, and has milk for them. She has use of her natural instincts and seldom destroys her pigs, either by accident or intent. It is wise to allow her an ear or two of corn each day in addition to what early cut alfalfa hay she will consume.

If it is summer time and she can have the run of the alfalfa field she will thrive with very little grain in addition until the pigs come. After that time it will pay to feed her a little more grain. The sucking pigs will soon learn to nip the tender leaves and stems, and that will add greatly to their thrift and growth. It pays largely, however, to feed corn in addition to alfalfa pasture to shotes. It is not necessary to feed so much as when they do not have access to alfalfa; about half the usual amount of grain will cause a fine, thrifty growth. At the close of their life period it is well to give whatever amount of corn they will eat up clean. In this manner is made the cheapest and best possible pork. Fed in this way an acre of alfalfa pastured with hogs has made a clear profit in one year of as much as \$25.00.

Corn is the best single grain to be fed in connection with alfalfa. Corn is rich in fat and low in protein. Alfalfa is very rich in protein and somewhat low in fat. These two should not be separated where flesh is desired. They most admirably supplement each other. Either for the fattening lamb, pig, calf, or steer the ration of corn and alfalfa is an ideal one, for they very nearly balance each other, and both can be produced on the farm, and both are adapted to most parts of the United States and much of Canada.

After corn, however, come barley and oats and wheat, valuable to supplement alfalfa, though of the three barley is best, being richer in fat making elements. Very good lambs are made with alfalfa and barley, or alfalfa and wheat, or alfalfa and oats, or with a mixture of them all together. Yet when corn is available at nearly the same price it is very much to be preferred.

The alfalfa field is a rich storehouse for the poultry keeper. In summer time the fowls forage far and wide, eating the tender alfalfa leaves, rich in protein, and finding insects. In winter time fowls will consume great amounts of alfalfa leaves and the fine stems. Sometimes alfalfa is ground into meal for poultry and swine. This is well, though when it is in large supply it is not necessary to do this, as it is cheaper to waste a part of the stems than to grind them into meal. Fowls given all the alfalfa that they desire are more healthy and lay many more eggs than without it.

The amount of fertilizing material that will come from an acre of first class alfalfa is equal to what would be bought in the bag for \$60.00. Now if the owner of a depleted soil can get one small field established in alfalfa, and will save the hay and feed it with care, saving all of the manure and putting it out upon another tract, he can thus enrich this sufficiently to make it grow alfalfa. Now let him have the two fields producing alfalfa, and using the hay again and saving the manure he is ready to enrich the third field. And thus gradually he may extend

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the area of his alfalfa land until some day, if that man has faith and keeps on, some day he may sweep the poverty altogether off his farm and find it redeemed, glorious in beauty in summer time and yielding him a steady and very great profit. Alfalfa is a clover, and enriches soils in the same manner that all clovers do by the growth upon its roots of bacteria, that have the power to fix nitrogen from the air. Then by its very deep roots it feeds upon the lower depths of the soil and draws up the stores of fertility that are down there. This may not be so well understood by readers who, living in the arid west, find all of their land ready to take alfalfa, but in the older clays of the rainy east, little land is now naturally in condition to take the seed until it has been first enriched.

Naturally the ways of sowing alfalfa vary with the location and climates. In the arid West is a simple matter. The land is usually plowed in winter or early spring, worked down to a good seedbed and the seed sown alone in middle spring time. It is irrigated occasionally according to the nature of the soil, and crops are often taken from it the same year, though it is not at its best until the third year, but it will yield very heavy crops the second year. In some countries it is a practice to sow a light seeding of oats with the alfalfa, in other regions this will not do since the oats will lodge or bed down and smother the slender alfalfa plants. In general the better practice in the arid region is to sow the alfalfa alone.

The amount of seed to the acre varies between four and thirty pounds. The smaller amount of seed is sometimes sown when seed is desired from it, as it seeds better not to be thick. There are 14,448,000 seeds in a bushel of alfalfa seed. Therefore to sow half a bushel to the acre would put 166 seeds to the square foot. To sow fifteen pounds would put on eighty-three seeds. Seeing that this is true, it is evident that it is more essential to have good seed and good distribution of the seed than to use a great amount of seed. About twelve to sixteen plants to the square foot are all that will ever stand, and on rich, deep soils they will not long endure even that much crowding.

Weeds often come up to crowd the young alfalfa. To destroy these weeds clip the field with the mower, setting it to run as close to the ground as possible. There may come a yellowish rust that attacks the leaves. To destroy this clip close with the mower. Therefore when preparing land for alfalfa, see to it that the field is left as smooth as practicable, so that the mower may run over it in security. This trouble of the leaf rust will not be so much in evidence in western lands as in the lands east of the Mississippi river.

It is not well to allow any animals to graze upon a young alfalfa meadow. They will likely do far more damage than the good they will get will pay for. When it is time for the alfalfa to be clipped, take the mower to it, and if there is enough stuff on the ground to be worth while, rake it up and take it away. After the first season, pasturing may be resorted to if it is thought desirable, and little bad results will be seen if the field is not over stocked.

In the region from the Mississippi river to the western limit of the rain belt, alfalfa thrives well, but more care is needed to get stands than in the arid region proper. Spring sowings are usual, without a nurse crop. A better plan is to plow the land early in spring or during the winter, and to work it up with disk or harrow as soon as the growing season has started weed life, and thereafter to harrow it after every rain until some time in late May or June, when the seed may be sown with confidence that it will not be choked with weeds, and that there will be enough moisture stored in the soil to carry it triumphantly through the hot summer. The essential thing in this plan is, however, to be certain to harrow thoroughly after every rain, not only to destroy germinating weeds, but to conserve all of the moisture. When the seed is sown it should be sown if possible with a drill, about one and one-half or two inches deep. Earlier in the season it is not necessary to sow it so deep. The depth that alfalfa seed may be sown varies according to the soil, but in most of this region the soils are black, loose and loamy.

A method that has given very fine results for the

past few years has been practiced in Iowa; it is the sowing after a crop of wheat or oats in mid-summer. To accomplish this the crop of wheat or oats is removed as early as possible and at once the land is plowed. Each day what is plowed is prepared with care to permit the escape of as little moisture as possible. The alfalfa seed is sown alone. It needs no clipping that year, goes safely through the winter and the next year gives three large crops of hay. The advantage of this method is that there is no loss of land and no trouble with weeds or foxtail grass, the great pest of alfalfa growers in the corn belt. Should the late summer prove unusually dry, this method might not be successful, and in case it is to be sown on clay that naturally freezes and thaws often during the winter and heaves badly, the young alfalfa roots might not be strong enough to resist. Thus far, however, it has given excellent results at the Iowa experiment station and is being adopted in other parts of that state. It is probably a system adapted to Illinois conditions, especially in the northern part.

The soils of this region are black and quite rich. And yet for many years they refused to grow profitable crops of alfalfa. It was found to be very difficult to grow alfalfa upon them. When it did grow it seemed often to be without nodules upon the roots, and therefore devoid of bacteria. A few years ago it was discovered that when stable manure was spread upon that seemingly fat, black land, alfalfa was easily established upon it and inoculation came naturally and abundantly. Now on all the soils of this region when well enough drained, alfalfa may be very profitably grown if care is taken first to liberally distribute over the fields stable or yard manure, working it into the soil to create there the ferment or yeast needed in that soil to start the bacterial life, and after it is once established it will endure profitably for a number of years; how long it is not yet possible to say.

The best method of sowing seems to be to break the land, after having thoroughly well manured and drained it, and plant one year to corn, keeping the corn clean of weeds and fox tail grass. The next year it should be again plowed as easily in winter or spring as it can be and deeper than ever before. After danger of hard freezing is over, say in late April, the seed is sown upon a nicely pulverized seedbed, at the rate of from ten to fifteen pounds per acre. At the same time a bushel of beardless spring barley is sown for a nurse crop. Oats are not admissible, since on this well manured land, they usually lodge and destroy the young plants beneath. The barley is taken off when ripe for grain and the young alfalfa is clipped at the same time. It may need one or two subsequent clippings, and it may not. The safe rule is to let it alone as long as it continues to grow thriftily. When it rusts and stops growing, or when fox tail grass or weeds crowd it, it should be mowed off close. The object of the barley is to discourage that marauder, fox tail grass, which it does quite effectually. Thus you will gain also the crop of barley for the use of the land. It is not usual to get much alfalfa after the first year of sowing. If any of the clippings make hay enough to be worth raking off, save them. Keep all animals off the field the first season.

It is sure death to the crowns to be tramped upon in cold weather, especially in the eastern states. Neither should wagons ever pass over the meadows in winter.

The time to cut alfalfa is when it has begun to bloom, the lower leaves to turn yellow and drop off, and buds to start out from the base of the stems. Cut then, for it has in its the greatest amount of nutrients. Allowed to stand longer, the stems become woody, some of the leaves are lost, and the hay is not so palatable, nutritious, nor digestible. If cut too soon, before the buds have set on the stems, sometimes the succeeding crop is seriously injured, for what reason is not yet known.

If possible, all of one crop should be cut down within a week, seeing that it is all ready at one time. Thus the hay is secured in best condition and the following crop is benefited by being given the space in which to grow. Wide cut mowers are convenient things in the alfalfa field. After the hay is laid down the haymakers should keep close watch, and as soon as it shows signs of drying and before the leaves will fall from the stems, it

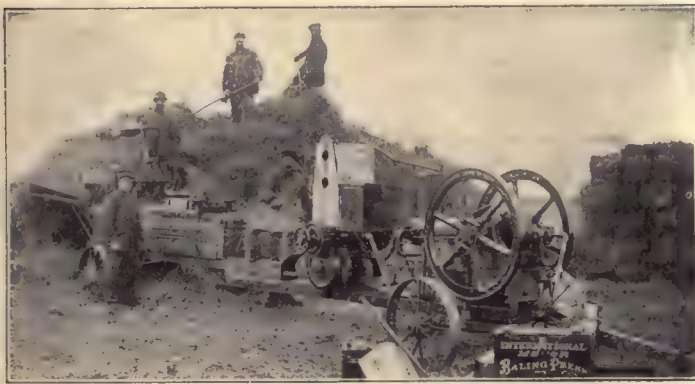
should be raked into small windrows and permitted to cure in part of the windrow, or in the cock, according to where you are and what sort of climate you must work in. Alfalfa dried in the swath loses many of the leaves when raked.

Side delivery hay rakes work well in alfalfa meadows, since they leave the hay loose, in good condition for drying. In eastern meadows, under showery conditions, the hay is best cocked up in small cocks while it is yet tough. Such cocks will turn rain well and may be afterwards opened out on a sunny day, or they may become dry without opening. Then, too, hay caps may be used on the cocks to advantage.

Take a wisp of the hay, choosing a damp part of it, and twist it violently into a rope. If no moisture can be made to exude from the stems the hay may be put into the mow or stack, especially if many tons are to be put together. If only a ton or two will be put into a small mow it should be well dried before putting away, since it is more apt to mould and become musty than when much is piled together.

There is a serious need in much of the black soil of this corn belt of more complete drainage than it has at present, before it is really fit for alfalfa culture. Men growing only corn, or corn and oats and timothy hay, have not usually a vivid conception of how wet their lands are during a good part of the year. In Illinois very much of the draining that has been done has been done superficially, with tile too close to the surface. These should be deepened so that none of them are at a less depth than thirty-six inches, and if they can be put down forty-eight inches all the better. Then there are needed other drains between the ones now in use. When this is done and some manure made use of, there is no doubt that very fine alfalfa fields can be maintained in Illinois.

It is hard for a farmer in the heart of the corn belt to consider seriously the demands of any other crop, yet if he will study alfalfa a little he will see that he is accepting no inferior plant when he puts it in place of some of his corn fields. Alfalfa will make on good land in that region a total yield during the season of



Motor Baling Press in Operation.

from four to eight tons per acre. Taking six tons as a standard, and calling the hay worth \$8.00 per ton, there is thus derived from that acre a gross revenue of \$48.00. To equal that amount the field must yield 120 bushels of corn which must sell at forty cents per bushel. Or, put it according to the amount of available and digestible carbohydrates and protein produced by these crops, the alfalfa will yield fully three times as much protein as the corn and double the carbohydrates, too! Furthermore, the alfalfa is not depleting the soil, while corn is a robber crop.

East of Illinois begin the clays, gravels, and loams that extend through Indiana, Ohio, New York, Pennsylvania, and the sister states. Few indeed of these soils are ready for alfalfa in their natural state, yet all of them will yield it most profitably when made fit for it. The requirements of alfalfa in these states are simple. It needs, first, to have the land drained, if it is not naturally dry. It requires that the land be sweet. In parts of Indiana, northern Ohio, in some of Pennsyl-

vania and New York there are acid soils. These must first be sweetened with lime before they will grow good alfalfa. The third requirement is that these soils be stored with organic matter, with humus. That means that they must be spread over with stable manure. After these three conditions have been met there is nothing but a little knowledge of the plant necessary to make it thrive admirably. The farm on which the writer lives grows now annually about 350 tons of alfalfa hay, though ten years ago little of its area was adapted to alfalfa at all. Tile underdrains and manure have made its growth possible, and it has proven very profitable.

Alfalfa sod is very hard to plow; with indifferent tools, impossible. It can be done with comfort, but it requires, first a good team of three strong horses; next, a plow, preferably a walking plow, in good repair, with a very sharp share. Next, it needs a sober and Christian hearted man. And it is a great aid to carry a file, and frequently file to a knife edge the cutting edge of the share. A little V shaped wing running horizontally out from the landslide under the edge of the uncut land about three inches is a great help, since it makes the plow run steadily and renders the next furrow far easier to turn.

Some of the alfalfa roots will not be cut off, and they will live over, doing no harm in the succeeding crop. All that are cut off will probably die, and there is no danger of alfalfa spreading beyond the original limits of its field.

Alfalfa seeds best in the dry parts of Kansas, Nebraska and westward. Usually the first crop is allowed to make seed. It is easily threshed, and in favorable seasons yields heavily, from one to fifteen bushels per acre being reported. The only seed worth much is the common alfalfa, but it is wise not to get seed from a latitude south of you.

Alfalfa will not thrive without the right bacteria upon the roots. Nor will milk sour without the bacteria of souring being present. And yet milk sours, and yet women folks do not add bacteria, knowingly, to their milk. Nevertheless milk will sour more rapidly if a little sour milk is added to the sweet at milking time. So alfalfa will surely become inoculated by natural processes if grown on fit soil, but it will the sooner become inoculated if earth from an old field is dried in the shed and pulverized and sown broadcast over the field and harrowed in. There are also cultures available that are used to inoculate the seed. They are sometimes of use. They often fail to be of use, through some defect in the method. It is not worth while to bother with cultures. It is worth while when sowing alfalfa on land that has never had it before to use soil from either an old alfalfa field or a sweet clover (melilotus) patch. The bacteria that live on melilotus are the same that live upon alfalfa.

Do not sow either alfalfa or bacteria upon soils not a fit home for bacteria. That means that the land should be dry, sweet, and stored with vegetable matter.

Bees love the blooms, especially in the western lands. Alfalfa honey is prime. Alfalfa covers the land with perennial beauty. It makes work for many laborers to gather the harvests and to feed the hay. It causes new homes to spring up, puts paint on school houses and sends little urchins trudging along country lanes with full dinner pails and smiling faces. It is one of God's richest gifts to man.

The Secretary of the Interior has ratified the award and execution of a contract on behalf of the United States with Mr. Jesse Hinds of Bayard, Nebraska, by which the latter agrees to construct high line lateral in connection with the North Platte irrigation project, Nebraska-Wyoming. The work involves the excavation of approximately 107,500 cubic yards of material, and the contract price is \$12,315. The location of this canal is about 13 miles northeast of Scottsbluff, Nebraska.

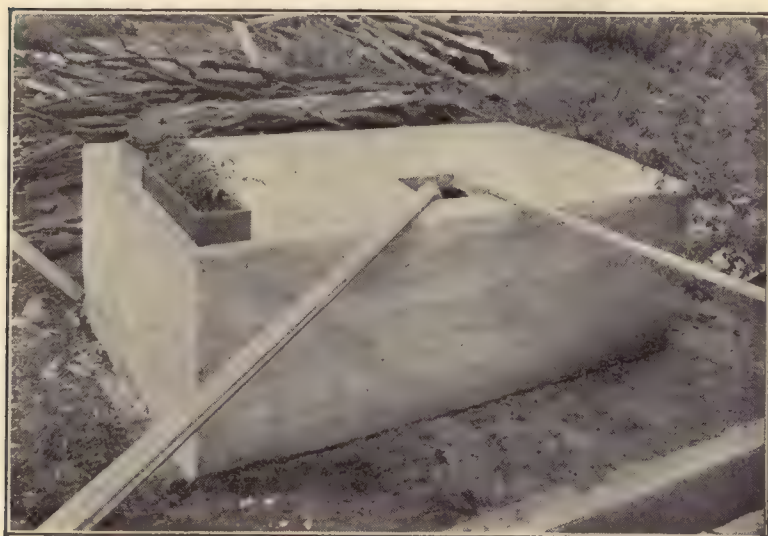
THIS SAVES YOU FIFTY CENTS.

Remit \$3.00 for one year's subscription to THE IRRIGATION AGE and one copy of the "Primer of Hydraulics," cloth bound.

CONCRETE CISTERNS ON TOP OF GROUND.

An abundance of soft water is a great aid in solving the labor problem of housekeeping. With the general use of concrete there has developed a new style of cistern which further lightens the work of the housewife. This new concrete cistern is built on top of the ground and, by direct pressure, forces the water through pipes into the house and does away with the work and exposure of pumping and carrying water. The piping of the water allows the cistern to be located to the best advantage. Since the roof water from out buildings is free from soot and other impurities, many persons prefer to build the cistern at the barn, granary, or corn crib. The cistern shown in the illustration is placed on a three-foot terrace in the rear of the house. The carrying of water is thus reduced to the mere matter of turning a faucet in the kitchen.

To illustrate the general method of construction, consider a cistern 8x8 feet square in the clear and 8 feet high



A Farm Cistern Built on a Three-Foot Terrace.

with 6-inch side walls and floor and 4-inch roof. Such a cistern holds 121 barrels of water.

The first step in building a cistern is to have all materials on hand before beginning the work. Make the forms or molds of 1-inch siding on 2x4-inch studding spaced 2 feet. Remember that the siding always goes next to the concrete. Since the floor is 6 inches and the roof 4 inches thick, have the studs for the outside form not less than 8 feet 10 inches in length. The uprights for the inside form must be exactly 8 feet long. As the pressure of the concrete will tend to hold the siding in place, tack it lightly to the studding. Board up the outside form only to height of 3 feet, so as to make easier the handling of the concrete and the placing of the reinforcing rods. Build each side separately in order that the entire form may be quickly erected. See that the forms are joined in such a way as to make their removal an easy matter when surrounded by the solid concrete.

From the site of the cistern strip off the sod and other foreign matter. Do not disturb the solid ground. Three to 4 feet below ground level (depending upon the depth of freezing), lay a 2-inch house-supply pipe and have the cistern end fitted with a pipe connection, set at the concrete floor level and 1 foot from the cistern wall. Carefully imbed the pipe in concrete to the first joint beyond the cistern wall. Thoroughly tamp back the earth removed, so that there can be no settlement underneath the cistern floor. Lay out the cistern 9x9 feet, out to out. Within these lines dig the foundation trenches 1 foot wide and 3 feet deep.

With the forms ready and the foundation trenches dug, begin mixing the concrete. Proportion the concrete 1 part Portland cement to 2 parts sand to 4 parts crushed rock. Four parts of clean bank-run gravel may be used instead of the sand and stone. In measuring the ma-

terials do not guess or count shovelfuls. Measure exact by means of a bottomless box, and count one bag of cement equal to 1 cubic foot. Mix the concrete, mushy wet and fill the trenches to a level with the under side of the cistern floor.

To take care of the water pressure, reinforcing rods must be run in both directions through the concrete wall. For this purpose, use $\frac{3}{8}$ -inch rods 10 feet long. While the concrete in the foundation walls is yet soft, set the vertical rods in it (spaced 8 inches) to the depth of 1 foot. Carefully place these rods so as to bring them within 1 inch of the outside of the cistern walls.

Next in order is the concrete floor. Make it 6 inches thick and tamp the concrete well. See that it overlaps the inside of the foundation wall and that the top of the pipe connection is at the floor level. Finish the surface with a steel trowel.

After the floor has hardened for 3 or 4 hours, erect the inside form. To aid in taking down these forms, place removable wedges between the ends of the studs and the floor. Before setting up the outside form, fasten the first four horizontal rods to the vertical reinforcing by means of small wire. These rods are spaced 8 inches apart. The ends must be bent and spliced around the corners of the cistern. Set the outside form and begin building the concrete side walls. Use the concrete mushy wet and work it down next to the wall form with a wooden paddle. Place it in 8-inch layers carried around the entire cistern. See that exactly 1 inch of concrete is between the steel reinforcing and the outside form. As the work progresses, add the necessary boards of the outside form and the lengthwise reinforcing rods. Do not stop placing concrete until the walls are finished.

While the 4-inch concrete roof is hardening, a temporary wooden platform is needed to support it. Build this platform of 1-inch boards nailed lightly to 2x4-inch joists. Let these joists rest on 2x4-inch stringers nailed to the studding of the inside form at a distance of 4 inches below their tops, so that when the stringers are loosened the platform will come down. To keep the mushy concrete from wasting, place heavy paper or thin cloth at the edges of the platform. For providing a manhole opening, take 1-inch boards 5 inches wide and build a bottomless frame 4 inches deep, 2 feet square at the top and 18 inches square at the bottom—outside measurements; or have the tinsmith make a round bottomless dish-pan of the same dimensions at the top and bottom. Grease the manhole frame and set it on the platform where the opening is desired. For the downspout from the roof, make an opening by similar use of a round wooden plug or a short section of drain tile or sewer pipe, which may be left in the roof.

Over the entire platform spread 1 inch of concrete. Quickly place the reinforcing of $\frac{3}{8}$ -inch steel rods running in both directions (criss-cross) and spaced 1 foot apart. Bend the ends to a hook shape and fasten them to the rods in the side walls. Immediately tamp in the remaining 3 inches of concrete. Increase the thickness to $3\frac{1}{2}$ inches at the center so as to shed the roof water. Finish the surface with a steel trowel. If the tin manhole frame is to be used, grease it, set it in place and build the cover along with the rest of the roof. Reinforce the cover with short lengths of rods laid criss-cross and within 1 inch of the bottom. As lifting rings, use two halves of an old bridle bit or two hitching past rings, the ends provided with knobs of twisted wire or with nuts and large washers for holding the bolts firmly in the concrete. If the wooden manhole form is used, carefully remove it after 5 hours. After 3 days build the manhole cover the same as for the tin form, with this exception—place greased paper around the edges to prevent the new concrete from sticking to that of the platform. When the cistern roof is 3 weeks old, lift off the manhole cover and saw an opening in the wooden platform. Descend, loosen the wedges under the studs and the stringers supporting the platform, remove the forms and pass them out through the opening. To keep the settlements out of the house pipe, screw a 4-inch length of pipe into the joint coupling. Fur-

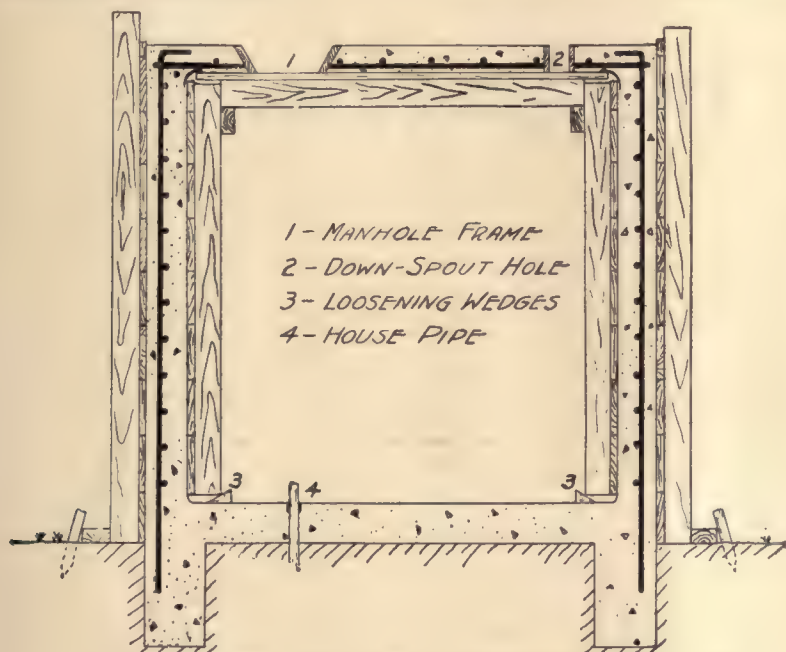
thermore, the downspout should be provided with a cut-off, so that the first flow from the roof of the building may be kept out of the cistern. The cistern may be used for water storage after it is 1 month old.

Below is given the bill of materials and a liberal estimate of their cost. By consulting local dealers, it may be found that the cost of the cistern can be reduced.

Crushed rock, 12 cubic yards, at \$1.10.....	\$13.20
Sand, 6 cubic yards, at \$1.00.....	6.00
Portland cement, 21 barrels, at \$2.50.....	52.50
Reinforcement (112 rods— $\frac{3}{8}$ inchx10 feet) 420 lbs, at \$0.02 $\frac{1}{4}$	9.45
	\$81.15

If ornamental features are desired, moldings or tile decorations may be used. The point to bear in mind is, that an inexpensive cistern located on top of the ground provides the country house with the conveniences of a costly city waterworks.

The prices of materials vary, of course, according to location and other factors.



Cross-Section of Cistern Built on Top of Ground Showing Forms and Reinforcing.

WEIGHT AND LENGTH OF ROOT SYSTEMS OF PLANTS.

Different investigators have found the following amounts of root systems for the common farm crops. The percentages are based on the dry weight of the aerial part of the plant, that is, the part above the surface of the ground:

Clover roots, 100 per cent of the weight of the total year's crop; brome grass, 100 per cent; wheat, forty-five per cent; oats, forty-five per cent and fourteen per cent; rye, fifty-two per cent; flax, thirty-four per cent; peas, fifty-two per cent and nine per cent; barley, thirteen per cent. These figures vary considerably, but they show that the root systems of plants are very extensive. There is a tendency for a greater development of root system under arid conditions, due to the greater distances which the roots must travel for water and to the greater difficulty which plants experience in absorbing the necessary amount of soil solution.

The total length of root systems of plants has been found to vary as follows: Barley, 128 feet; oats, 150 feet; wheat, 268 feet, and 1,800 feet; rye, 385 feet; a corn plant in the upper three feet of soil, 1,452 feet, and a full grown pumpkin vine, fifteen and five-eighths miles.

It has been observed that root systems tend to greater length in a richer and more porous soil. In one case a barley plant produced 128 feet of roots in a

rich garden soil and a similar plant in a coarse-grained compact soil produced only eighty feet of roots. Other conditions being equal the root systems of plants usually develop in proportion to the development of the aerial parts.

D. W. FEAR.

Colorado Agricultural College, Fort Collins.

SMALL FARM UNITS MORE PROSPEROUS THAN LARGE ONES.

In compliance with the requests of numerous settlers on the irrigation projects of the government the Secretary of the Interior has issued the following regulation governing the subdivision of farm units:

1. A homestead entryman subject to the Reclamation Act may relinquish a part of his farm unit and have the payments which had been made on the relinquished part credited to the charges on the retained part, provided that the amendment in question may be allowed without jeopardizing the interests of the government in the collection of the charges against the portion of the tract relinquished.

2. The entryman desiring to make such relinquishment should submit his application therefor to the project engineer, who will transmit the same with his recommendation through the proper channels to the director, who, if he finds no objection, will proceed as in other cases of proposed amendments of farm units.

This ruling is regarded as one of the most important of recent years relating to the reclamation work. It is a confirmation also of the prediction which the officials of the Bureau made several years ago that the greatest successes on the reclamation projects would be those on the small farms. The requests for permission to subdivide their farms comes almost without exception from the men who have taken up land in excess of their ability and means to cultivate. While the large land holder has been wasting his energy, time, and capital in an attempt to subdue his farm, and now finds the burden too great for him to meet the charges for building, operation and extra labor, the small farmers as a general rule have prospered and are slowly but surely gaining a competence.

Strong influence was brought to bear upon the department in the beginning to fix the farm units at not less than 160. Every effort was made to convince the department that a man could not make a living on less than this acreage. The most in-

fluential advocates of the large farm were the prominent farmers and business men in each of these communities. In this connection a recent letter from Col. H. W. Rowley, the president of the Billings Chamber of Commerce, is particularly interesting in view of the fact that until recently he was apparently in doubt as to the small farm idea:

"I am most earnest in favoring the small farm unit for this section of the country. The forty-acre farm unit, as established on the Huntley U. S. Reclamation project has proved a great success, and as a whole, it is perhaps today the most prosperous section in our country, due entirely to the small farm units. Our experience certainly is that the small twenty to forty acre farmer is as a rule successful, while the large units are not.

"One of the most important problems that our Chamber of Commerce will deal with during the next year will be to educate our people to the advantage of the small farm unit devoted to diversified farming. When this is brought about we will have a wonderfully productive country capable of sustaining a very large population of successful home builders."

Yours very truly,

(Signed) H. W. ROWLEY.

On some of the projects, the department, yielding in part to the importunities of the people, fixed the units at 80 and 40 acres each, and has often since had occasion to regret that it did not insist upon the smaller unit.

The new ruling, however, will go far to correct the mistake which was then made, because it will encourage the subdivision of the large units and will relieve the farmers of a portion of the charges now assessed against them. It will accordingly make for more intensive cultivation of the land which they retain, will eliminate the expenses in part of the hired help, and will insure larger returns from the lands in crops. It increases the number of farm families, as each relinquishment will provide for a new home on the land.

THE V-SHAPED COTTON-STALK CUTTER.*

The wisdom of destroying cotton plants early in the fall in the clean-culture method of combating the boll weevil² is generally admitted, but planters often fail to do this in the belief that it is an expensive operation, likely to interfere with other pressing farm work. W. Newell and M. S. Dougherty, of the Louisiana crop pest commission, describe a cheap and effective homemade implement which makes it possible for one man and two horses to cut, windrow, and burn 10 to 15 acres of cotton stalks per day, at a cost of from 25 to 35 cents per acre on uplands and from 35 to 50 cents per acre on alluvial lands. This implement, known as the V-shaped cotton-stalk cutter (Figs. 3 and 4), has been in general use for several seasons in different sections of Louisiana. It may be made at home from the following materials:

- 2 pieces lumber, 4 by 4 inches, 9 feet long.
- 2 pieces lumber, 4 by 4 inches, 5½ feet long.
- 1 piece lumber, 4 by 4 inches, 7 feet long.
- 1 piece lumber, 2 by 6 inches, 3 feet long.
- 1 piece of iron, ¾ inch by 2 inches, 30 inches long.
- 2 pieces of iron, ¾ inch by 1½ inches, 24 inches long.
- 12 bolts, ¾-inch, 6½ inches long.
- 10 bolts, ¾-inch, 4½ inches long.
- 1 bolt, ¾-inch, 4 inches long.
- 1 bolt, ¾-inch, 7 inches long.
- 2 bolts, ¾-inch, 9 inches long.
- 45 bolts, ¼-inch, round heads, 4½ inches long.
- 45 large washers to fit the ¼-inch bolts (needed if the blades are to be made from cross-cut saws, as indicated below).
- 2 steel blades, about ⅝ inch thick, 3 to 4 inches wide, and 6 to 7 feet long, sharpened on one edge (or, better, two old cross-cut saws from which to make the blades).

Only sound, well-seasoned cypress should be accepted. As the six pieces required contain about 50 board feet, the cost

for lumber is usually about \$1. The bolts required cost about 80 cents, the iron for making the clevis and rudders about 50 cents, and the steel blades about \$1 each. If old saws are readily obtainable, they may be used, and the price of the blades saved. The total cost for materials will, therefore, range from \$2.30 to \$4.30, depending on the variable local prices of lumber and hardware, and whether new material must be purchased for the blades. If the farmer has no forge it may be necessary to add the charges of a blacksmith.

The two 9-foot pieces of cypress (aa) and the 7-foot piece (b) should be cut and bolted together as indicated in figures 3 and 4. Before they are bolted together an

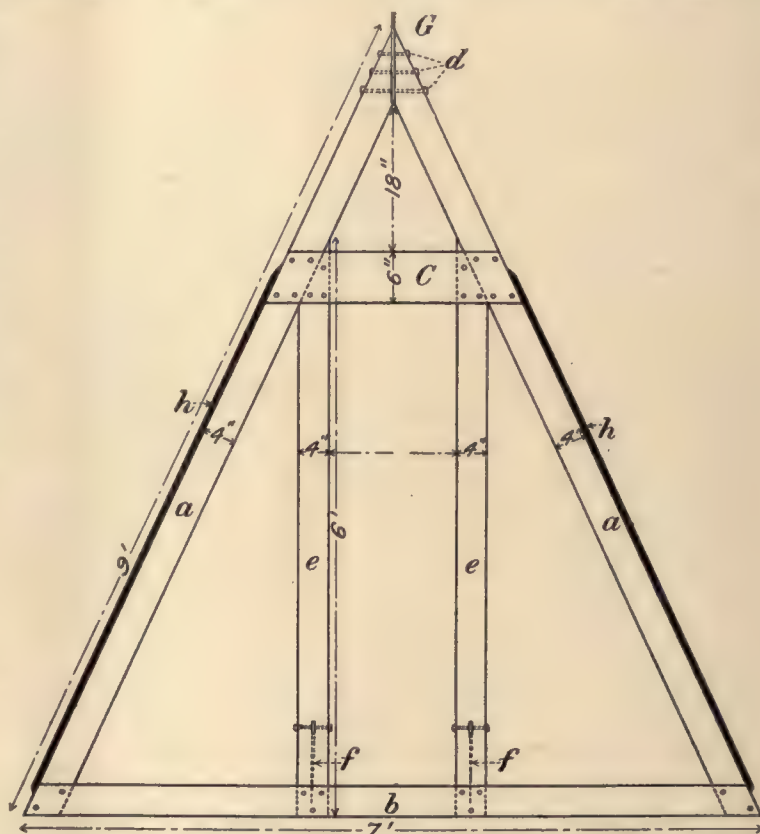


Fig. 3.—The V-shaped Cotton Stalk Cutter, Top View.

opening should be chiseled in the top of the longer piece to receive the clevis attachment at G.

The clevis attachment is made by bending at right angles a piece of iron ¾ by 2 by 30 inches. It is bent edge-wise about 12 inches from one end. Three holes should be drilled 2 inches apart in the 12-inch arm to receive the 4, 7, and 9-inch bolts (Fig. 3d), which fasten together the two 9-foot pieces of cypress (aa). Six ½-inch holes 1½ inches apart should be drilled in the upper portion of the 18-inch arm of the attachment clevis for use in hitching to the cutter and in regulating the depth at which the blades cut.

The rudders (ff) should be made of iron pieces ¾ by 1½ by 24 inches, bent at right angles 8 inches from one end in the same manner as the clevis. The outer edge is beaten thin to cut through the ground without unnecessary friction. Six holes 1 inch apart should be drilled in the 16-inch arms of the rudders to permit them to be raised and lowered as the height of rows in the field varies.

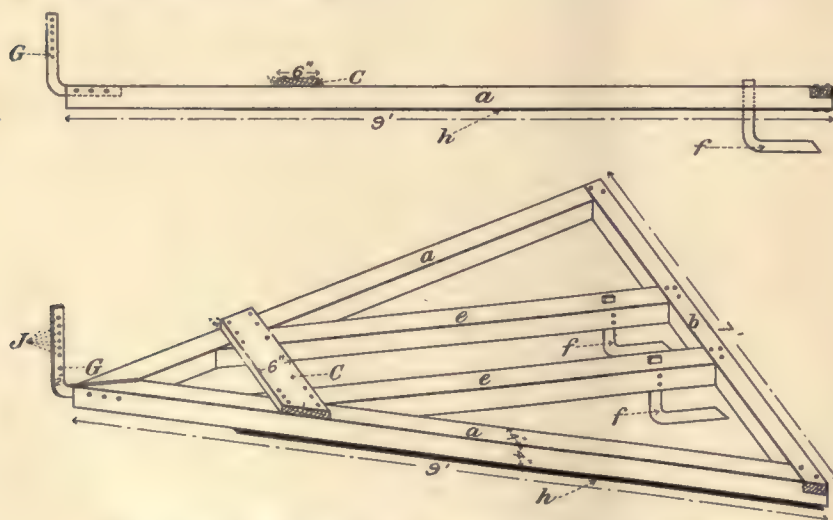


Fig. 4.—The V-shaped Cotton Stalk Cutter, Side View and Perspective.

*Compiled from Crop Pest Com. La. Circ. 30 and U. S. Dept. Agr., Farmers' Buls. 344, p. 18; 457, p. 11.

The blades (hh) should be 6 or 7 feet long and wide enough to bolt firmly to the under side of the 4 by 4 pieces (aa) and still extend the cutting surface $1\frac{1}{2}$ inches outside the wood. They should be of well-tempered steel. Old cross-cut saws with the smooth edge filed to sufficient sharpness make excellent blades when securely bolted on.

When the side pieces (aa) and the base (b) are bolted together with $\frac{3}{8}$ -inch bolts, the clevis attachment should also be bolted in place. Additional bolts back of the clevis will add to the rigidity of the cutter. The 3-foot piece of 2 by 6 cypress (C) should next be bolted to the side piece (aa) and the $5\frac{1}{2}$ -foot piece (ee) bolted to it and mortised into the base (b), as indicated in figures 2 and 3. These are the rudder timbers and should contain openings about a foot in front of the base (b) of suitable size to receive the 16-inch rudder arms (ff). Two bolts through each rudder and rudder timber should hold the rudders in place. When in addition to these steps the blades (hh) have been securely bolted to the under sides of the side pieces the machine is completed. The blades should project $1\frac{1}{2}$ inches and extend to the rear corners of the machine. If the blades are curved because made from cross-cut saws, or from any other reason, they should be so set as not to project more than $1\frac{1}{4}$ inches to $1\frac{1}{2}$ inches at the centers. In any case plenty of bolts should be used and absolute rigidity secured.

The stalk cutter is sometimes constructed with but one rudder and rudder timber. In this case the rudder is in the center of the machine, and runs half way between the rows where the ground is usually hard. It does not go deep enough to hold the machine steady and the lack of weight also contributes to unsteadiness. The two-rudder machine with the rudders running in the soft dirt at the sides of the rows go in deep enough to prevent skidding.

In using the cutter it is necessary to keep the blades very sharp by filing or other means. They should be so adjusted as to cut the cotton stalks at or just beneath the surface of the earth. Their depth is regulated by raising or lowering the chain by which the singletree is attached. If the machine runs too shallow the attachment should be raised to a higher notch in the attachment clevis (J, Fig. 4). The rudders should be set deep enough to prevent skidding, but not deep enough to make the machine pull too heavily.

Where no fence surrounds the field two horses or mules should be hitched tandem to the stalk cutter in order that both may walk in the middle and pull steadily. If the field is fenced this arrangement will prevent cutting of the stalks at the ends of the rows and the two horses must be driven abreast. It is absolutely necessary that not a single green cotton stalk be left uncut in the field or at its edge if the weevils are to be starved. For this reason the field should be carefully gone over and every stalk that the machine has missed should be cut with a sharp cane knife.

SHOWS GREAT INTEREST IN IRRIGATION.

Professor S. McIntosh, commissioner of agriculture for South Australia, has passed two weeks in Chicago, conferring with other irrigation leaders, and incidentally buying considerable machinery.

His long trip began last spring, when he went to Europe. Since coming to this continent he has traveled the whole length of Canada, going directly from Montreal to Edmonton. Then he came across to Colorado, and east to Washington and New York. His main objects have been to study farm conditions in various sections, and secure a large outfit of machinery for use in carrying on his irrigation projects in Australia. He found the machinery which he desired in Chicago and placed with dealers and manufacturers here one of the largest individual orders on record.

Prof. McIntosh timed his visit to this country for the big irrigation conventions and farm expositions, where he has been able to gain the information he sought regarding American methods of agriculture. He has met many of the leading men of America. It is hardly sufficient to say that he is an expert on the subject of irrigation, for he is an acknowledged authority on agricultural subjects generally and one of the brightest men heard at the recent big meetings in this country. He is an enthusiast on the question of intensive and diversified farming.

Since becoming director of irrigation for South Australia, several years ago, he has conducted an extended series of experiments to prove the value of an artificial water supply, and to establish a theory that men ought to accomplish as much on forty or fifty acres as they ordinarily do on 160 acres. He keeps several practical farmers at work on government land to demonstrate his views and the results fully have justified the efforts.

Regarding our American condition Mr. McIntosh expressed himself as follows:

"You have many practical irrigationists in the west,



S. McIntosh, Director of Irrigation for South Australia.

and the principle of providing a water supply as an adjunct of farming is well established in certain localities. It is surprising to me that it is not more generally recognized as an essential. I am informed that in the spring wheat states, where they have been having successive droughts, irrigation received a good start twenty years ago, but has been abandoned since then, either from a false idea of security or in fear of the expense.

"In the middle west there is little irrigation sentiment, although there have been three successive droughts in this section which have caused untold loss among the farmers. Much of that loss would have been avoided had there been a simple and inexpensive irrigation system. In a wheat country a sufficient and regular water supply insures crops in excess of twenty bushels per acre. Twenty-five to thirty bushels is no uncommon thing.

"It is much the same with corn, although that is a crop which stands drought better than wheat. Our tests year after year in south Australia, made on large farms where the general conditions were similar, show that for wheat, fruit and vegetables the irrigated land yields about double as much as the unirrigated. Now, in Minnesota and the Dakotas a ten-year average for wheat is fourteen bushels. That is just about cost at the prices that are paid there; but suppose they had been getting twenty bushels as the minimum, with a range up to thirty, there would be a very different degree of prosperity.

"But that is not all of the argument. Your official reports show an average yield of wheat in South Dakota this season of only five bushels per acre. A year ago there was the same condition in North Dakota. Of course, if the farmers there have considerable live stock they can pull through, but to the exclusive grain raiser it is ruinous.

"In the Illinois dairy country the drought has for three years cut down the midsummer milk supply about 50 per cent. Pastures were parched and withered for at least three months of the summer in 1909 and 1910, a time when milk ought to be produced cheapest, and for perhaps two months this last summer. That accounts for the rush to put up silos and to prepare for summer feeding. What a difference it would make in the fortunes of Illinois dairy owners if they had a system of irrigation which would insure good soiling crops for the dairies, as well as larger corn and wheat crops!"

Mr. McIntosh has developed methods of double cropping especially for dairy purposes, which he tells of in an instructive manner. He asserts that it is feasible to take off a crop of rye and clover in June and follow it the same season with millet or fodder corn. There are many other combinations which he insists can be tried without injuring the land. After a crop of oats is harvested it is a good time to sow rape. This should be kept as a forage crop for a couple of years. It is invaluable for hogs or sheep and restores the land after it is worn by oats, corn or other grain. Potatoes may follow any of the early crops and are valuable for rotative purposes.

STORAGE FOR ROOT CROPS.*

E. J. Delwiche, of the Wisconsin station, makes the following recommendations regarding the storage of roots for feeding purposes:

"The best place to store roots is in a root cellar near where they are to be fed. Such a cellar may be a part of a barn basement, or it may be built conveniently near to the stock barn. In most places the root house can be built most economically of concrete. Ordinarily cement is the only material that has to be purchased. The gravel and sand are usually available at no great distance on most farms. While the temperature in a root house should never fall to the freezing point, it should be at a low point for best results in keeping roots.

When no cellar is available, roots may be stored in pits. For fall and early winter feeding they need not be covered to any great depth. The roots are put in a conical pile about 4 feet in diameter on a bed of clean straw, then covered with a layer of 2 inches of long straw. Clean rye straw is preferred for this purpose. The straw at the apex of the pile is made to form a chimney 5 or 6 inches in diameter for ventilation. Dirt is thrown on the pile to a depth of 6 inches. The roots are piled as high as possible so as to shed water. When wanted for feeding the whole pit is taken into the barn at once. For early winter feeding the layer of dirt should be thicker, and in addition a covering of straw or horse manure should be placed over the whole pile.

Figure 5 illustrates a pit intended to remain over winter. This provides for two layers of straw and two of earth. A ventilator made of 4-inch boards is placed at the apex. When severe freezing weather sets in, the ventilator is stuffed tightly with fine hay. In such a pit roots

will keep without freezing even in the coldest winters. If desired, the piles may be made oblong instead of conical in shape, retaining the gable form. While pits do very well, so far as keeping the roots is concerned, it must be understood that they are but makeshifts at best. A root house which is accessible at all times is much more satisfactory and more economical in the long run."

NEBRASKA IRRIGATIONISTS.

THE IRRIGATION AGE acknowledges an interesting visit from two practical Nebraska men, I. S. Walker and P. Maginnis of Kimball. These gentlemen attended the session of the recent Irrigation Congress and were in Chicago several days, bringing the merits of the Kimball district to the attention of farmers and investors.

Mr. Walker is President of the Kimball Irrigation District and Mr. Maginnis is patentee and manufacturer of the Maginnis steel flume, which is known in irrigation circles the world over.

The gentlemen were enthusiastic over the development of the Kimball district. Their town is on the main line of the Union Pacific, four hundred and fifty miles west of Omaha and one hundred and seventy miles east of Denver.

Kimball is a natural business center and has the

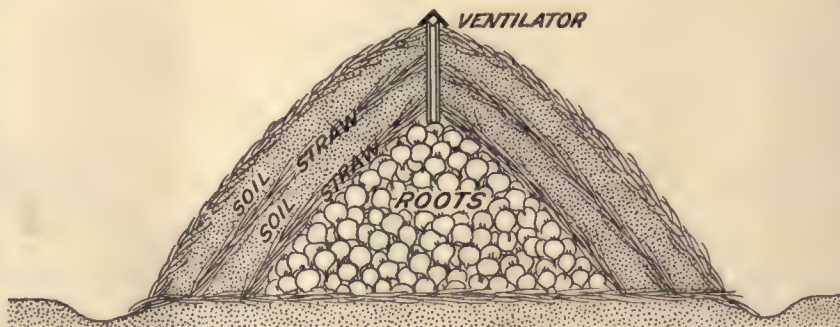


Fig. 5.—Cross Section of an Easily Constructed Pit for Roots.

advantage of a vast basin which, as improved, is known as the Oliver reservoir. It lies across Lodgepole Creek and meets the irrigation requirements of a large tract.

The Kimball irrigation district project is owned and operated by the people residing in the district. The money for construction was obtained by a bond issue, and the major part of these bonds were purchased by Kimball residents and people interested in the district. No money was paid in commission for the sale of these bonds and not one dollar was absorbed for the promotion of the enterprise.

This project has an ample supply of water for the entire acreage and people in the most moderate circumstances may here build homes for themselves.

*Compiled from Wisconsin Sta. Circ. Inform. 16.

THE PRIMER OF HYDRAULICS*

By FREDERICK A. SMITH, C. E.

XIV. Closed Channels.

1. Rectilinear Channels.

Of the various forms of closed channels, the cylindrical and composite forms will be especially considered, as all the others bounded by right lines are readily solved by the preceding articles; for instance a closed channel of rectangular section will be considered an open channel until it flows full; then the hydraulic radius undergoes an immediate change. As shown before, the hydraulic radius varies directly with the height in an open channel; but if $ABCD$ (Fig. 89) represents a closed channel, then when the height of

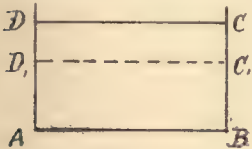


Fig. 89.

flow reaches the top DC , the wetted perimeter is increased to the extent of the face DC , and causes a considerable reduction in the hydraulic radius; for instance, let $AB = 4$ ft. and $AD = 3$ ft.; then just before the water reaches DC we have

$$r = 3 \times 4 \div 3 + 4 + 3 = 12 \div 10 = 1.2.$$

Then the moment the water reaches DC :

$$r = 3 \times 4 \div 3 + 4 + 3 + 4 = 12 \div 14 = .857;$$

in case the cross section is a square with the side a , then $r = a^2 \div 4a = a/4$ in the case of a closed channel.

Similar deductions may be made in regard to closed channels of triangular and trapezoid sections, each of which is considered an open channel until the roof becomes immersed, when the reduction of r must be considered.

2. Cylindrical Channels.

Channels of circular cross sections are the most generally used and of the greatest industrial importance, as most sewers and water tunnels are at present of that form, and practically all water mains and supply pipes. While most sewers are ordinarily flowing only partially full and only occasionally are completely filled, water pipes as a usual thing are flowing not only full but often under considerable pressure; therefore the problems of the cylindrical channel comprise three varieties: First, channels flowing partially full; second, those flowing full, and third, those flowing full under a considerable pressure. These various phases are now explained by different applied problems.

3. Applied Problem.

A brick sewer 16 ft. diameter drains a territory of 4,000 acres, and the dry weather flow delivers .011 cu. ft. per second per acre, while the storm flow equals .10 cu. ft. per second per acre; the slope of sewer is .0001 and coefficient of roughness .015; find depth and velocity of dry weather flow, also depth and velocity of storm flow.

Solve dry weather flow first.

Total flow equals $4,000 \times .011 = 44.0$ cub. ft. per second. To begin, assume a probable hydraulic radius, say 1.44 feet. Draw a diagram as indicated in Fig. 90, in which the line AB represents the height of flow and ED is the versed sine.

Then $\sqrt{1.44} = 1.2$; turn to table VI; we find under slope .0001 opposite $\sqrt{r} = 1.2$, so $C = 101.77$, say 102 for short; then $v = 102 \times 1.2 \times .01 = 1.124$ ft. per second; find area corresponding to $R = 1.44$, in table XV. Divide 1.44 by 16 = .09, which is hydraulic radius constant and agrees with area-constant .071; multiply .071 by the square of diameter $16 \times 16 = 18.18$, which is area of segment; multiply by velocity 1.124, gives the quantity of flow = 20.36 cub. ft., which is too small, and hence the value of r must be increased.

Next assume $r = 1.96$, hence $\sqrt{r} = 1.4$.

In table VI under slope .0001 opposite $\sqrt{r} = 1.4$ we find factor $C = 108.96$, say 109.

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Then $v = 109 \times 1.4 \times .01 = 1.526$.

Find area corresponding to $R = 1.96$ (table XV). Divide 16 into 1.96 = .125, which is hydraulic radius constant in table XV, lying about half way between .1206 and .1311; so the corresponding area constant lies between .1182 and .12811, or .1199; multiply by $16^2 = 256$ which gives 30.48; multiply this by $v = 1.526$, gives 46.52, cub. ft., which is slightly too great, but near enough for practical purposes; hence the versed sine of flow will be between .20 and .22, say .21, which, multiplied by 16, gives 3.36 ft. for depth of dry weather flow.

To find the depth and velocity of the storm flow, proceed in like manner. Calculate the maximum storm flow for 4,000 acres at .10 = 400 cub. ft. water. Assume a probable hydraulic radius at 4.0, or sewer flowing half full; then $\sqrt{4.0} = 2.0$. Turn to table VI; we find under slope .0001 opposite $\sqrt{r} = 2.0$ the factor $C = 125.13$; then $v = 125.13 \times 2 \times .01 = 2.5$; find area corresponding to $R = 4.0$, which is half of area of full 16 ft. circle = 100.53; multiply this by 2.5 gives 251.32 cub. ft. per second; this is too small, so assume a larger hydraulic radius; assume \sqrt{r} at 2.20; table VI shows $C = 125.13$, say 125. at $\sqrt{r} = 2.0$; at $\sqrt{r} = 2.5$; $C = 134$, so for $\sqrt{r} = 2.2$ the factor C equals $2/5 \times 9 = 3-3/5$, which, added to 125.13, makes 128.73, or about 129.0.

Then $v = 129 \times 2.2 \times .01 = 2.84$ ft. per second. Find area corresponding to $R = 4.84$; divide 16 into 4.84 = .302 (hydraulic radius constant, table XV); this agrees with area constant .63185 and versed sine .75; so multiply .63 by $16^2 = 161.28$ sq. ft.; multiply this with $v = 2.84$, gives 458.03 cub. ft. per second; this indicates that the maximum flow of 400 cub. ft. per second will not reach the .75 $\times 16 = 12$ ft. and r is taken too high, but we have limits established, as the depth of flow lies between 8 ft. and 12 ft., and \sqrt{r} must lie between 2.0 and 2.2; assume $\sqrt{r} = 2.1$ then $C = 127$, and $v = 127 \times 2.1 \times .01 = 2.67$ ft.; $r = 4.41$; divide 16 into 4.41, gives .28; in table XV this brings area constant .492 and versed sine .60; multiply .49 by $16^2 = 145.44$ sq. ft.; multiply by 2.67, gives 388.32 cub. ft. This is very near the requirement, and by multiplying 16 by .6 we get depth of flow, 9.6 ft. This evidently shows that the size of the 16 ft. sewer is too large for the maximum flow of 400 cub. ft. per second.

4. Find the Necessary Size.

Another useful problem to work would be: Find size of a circular sewer to carry a maximum flow of 400 cub. ft. per second when $s = .0001$ and $n = .015$. As the maximum flow obtains if height of flow area = .930 we will assume the sewer flowing .93 full at that rate; the hydraulic radius constant is then .2918, so that in a circle of diameter = 1, the area would be .7612, and $r = .292$, and wetted perimeter 2.61 (see table XV). Assume a sewer 12 ft. in diameter; then at .93d area equals $12 \times 12 \times .7612 = 109.61$ sq. ft.; divide this into 400, gives $v = 3.65$. Now check v as follows: $r = 12 \times .292 = 3.50$ and $\sqrt{r} = 1.86$. In table VI find $C = 121$; then $v = 121 \times 1.86 \times .01 = 2.25$. It is seen that v is too small, hence a larger sewer must be used.

Try $d = 14$ ft.; then at .93d area equals $14 \times 14 \times .76 = 148.96$ sq. ft.; divide this into 400 gives $v = 2.77$ ft. per second. Now $r = 14 \times .292 = 4.09$, and $\sqrt{r} = 2.02$; in table VI we find C for $\sqrt{r} = 2.02 = 125$; then $v = 125 \times 2.02 \times .01 = 2.53$ ft. per second, giving a total flow of 348.56 cubic feet.

This diameter is still too small, so try $d = 15$ ft.; flow area at .93d = $15 \times 15 \times .76 = 171.0$ sq. ft.; divide into 400 gives $v = 2.34$, $r = 15 \times .292 = 4.38$ and $\sqrt{r} = 2.09$; $C = 127$ (table VI); then $v = 127 \times 2.09 \times .01 = 2.63$, which is greater than necessary, as $2.63 \times 171 = 449.73$ cub. ft.

This size would probably be selected, as there would be an excess in capacity of nearly 50 cub. ft. per second, which would be on the safe side.

5. Find the necessary slope.

Another class of problems will present themselves. Suppose it should be desirable, for good reasons, that the diameter of the sewer should not exceed 12 ft.; then it would be necessary to increase the slope s , which factor is now to be developed.

When flowing .93 full the flow area = 109.61, requiring a velocity of 3.65 ft. per second (see above). On a slope

$s = .0001$ we obtain a velocity of 2.25; let x = required slope, then:

$$\sqrt{x} : \sqrt{.0001} = 3.65 : 2.25, \text{ hence} \\ .01 \times 3.65$$

$$\sqrt{x} = \frac{.01 \times 3.65}{2.25} = .0162; \text{ then } x = .0162 \times .0162;$$

hence $s = .000266$, which is the required grade. To check this, find flow of 12 ft. sewer flowing .93 full on above grade. R is found from table XV by multiplying .2918 by 12 = 3.502, and $\sqrt{R} = 1.87$. From table VI under slope .0002 and for $\sqrt{r} = 1.8$ we find $C = 120.5$; hence we find $v = 120.5 \times 1.87 \times .0162 = 3.65$ ft.; the flow area in the 12 ft. sewer equals $12 \times 12 \times .7612 = 109.61$ sq. ft., hence the maximum flow will equal $109.61 \times 3.65 = 400$ cub. ft. per second. This is slightly less than the real capacity, as the factor C was evidently taken for $\sqrt{r} = 1.8$; for $\sqrt{r} = 1.87$ it should be taken larger in proportion, as follows:

C for 1.8 = 120.5.

C for 2.0 = 124.5.

This is a variation of 4 units for an advance of .2 in the \sqrt{r} ; then the proportional part for 1/10 would be 2 units, for 1/100 it would be .2, and for 7/100 it would be 1.4; this should be added to 120.5, which makes the true $C = 121.9$; this increases $v = 3.79$ and the maximum capacity to 415.52 cub. ft. per second.

The foregoing illustrations show how to handle problems of circular conduits flowing partially full.

HOMESTEADS.

Settlement upon land while it is covered by the entry of another confers no right on cancellation of the entry as against the government.

The government's rights under any valid withdrawal at once attach to the exclusion of any settlement or other right initiated while such entry was of record.

In construing Section 2289 of the Revised Statutes, the maxim, "*De minimis non curat lex*," cannot properly be invoked to justify a plain disregard of the statutory limit as to the area of the land ownership disqualifying from homestead entry. Case of *Amidon vs. Hagdale* (39 L. D., 131) overruled.

The homestead law is a donation of public lands conditional upon the performance of certain acts. Its purpose is to establish agricultural homes on the public domain, and, in case of the death of the entryman, the widow or heirs should proceed at once to cultivate during the proper season of each year and improve the land, and continue such cultivation and improvement for such period of time as, when added to the time during which the entryman had complied with the law, would make compliance for the full period required by the statute. Citing *Schooley vs. Heirs of Varnum* (33 L. D., 45).

The law requires merely an annual expenditure to the requisite amount in good faith for purposes of reclamation. It does not require the first or any other annual proof shall effect reclamation, but the expenditure must be necessarily intended to effect it, and the reclamation must be effected within the time allowed. Citing *Stevenson vs. Scharry* (34 L. D., 675).

Mere expenditure to a required amount cannot be accepted as compliance with the law, but the reasonable value of the work done is the criterion, not the amount the entryman claims to have expended for it. Citing *Bradley vs. Vasold* (36 L. D., 106).

When land is withdrawn of record under provisions of law, in anticipation of an irrigation project, a prior entry thereof may be allowed when it appears that the land embraced in the entry is subject to irrigation and to a large extent irrigated from a private irrigation ditch, and is so situated as not to be irrigable from any government project in course of construction or even in contemplation.

ENCOURAGING IRRIGATION.

Mr. C. J. Blanchard, statistician of the U. S. Reclamation Service, has just returned from an extended trip of investigation in the west, covering more than 16,000 miles. During a portion of the trip he accompanied Secretary Fisher of the Department of the Interior.

"The irrigated West as a whole is enjoying the prosperity which always accompanies good crops," said Mr. Blanchard. "Our inland empire, which includes a large part of Idaho, Montana, Washington and Oregon, was bountifully blessed with rich harvests. The yield of wheat on the dry uplands are heavy, while the irrigated valleys report the usual tonnage of hay, sugar beets and a big crop of apples. The latter crop promises to be the best in several years in size and quality.

"The most striking and impressive feature of the rapid development of the Great American Desert is the growth on the small farms. Intensive farming, careful and thorough cultivation, are shown on all the reclamation projects. The majority of these farmers show a high order of intelligence. All the details of planning model farms are well thought out, and the consideration of the home itself has not been overlooked. Many of these valleys were uninhabited and covered with sage-brush a half a dozen years ago. Today they present the appearance of an old-settled country. Artistic and beautiful homes, already shaded with cottonwood and locust trees, are located at well-placed intervals along the main highways, in many sections 16 to 32 of these houses in each mile. Broad vistas of alfalfa and grain fields have replaced the sage-brush. Cities and towns, ranging from several thousand to a few hundred in population have sprung up. The dweller in the town has not been behind the tiller of the soil in planning his home or pride of his town. Parks, boulevards, and lawns are well kept, and the character of the business blocks are indications of the substantial foundation upon which the community has been established. One cannot visit these growing centers of wealth and beauty without being impressed with a feeling of pride in the courage and abiding faith of these pioneers who have waged successful battle with the desert. In this land of sunshine you hear but little about failure, and you see but little want and poverty.

"I visited many of our irrigation projects this summer, and without exception noted a marked improvement in the condition of the settlers. Many of them, and especially those whose means were limited, have encountered difficulties and hardships. A few have been discouraged and have given up the fight, but a large majority have made good. The government has been learning something, too, about the actual requirements of successful farming in the desert, and Secretary Fisher has expressed a willingness to extend to the settler all the assistance and co-operation which can be given under the law. As he well expressed it in one of his speeches, "The obligation of the government is first of all to the man now on the land rather than to the settlers who may come later. Where the difficulties in establishing a home are greatest by reason of unfavorable conditions of soil or climate, he will put into effect a system of easy graduated payments, making the burden upon the settler lighter during the first years on his land. Some of the provisions of the law are onerous and work hardships upon the settler. Congress undoubtedly will be asked to modify them."

Twenty-five farmers living in Otter Creek valley, west of Mountain Park, Okla., are preparing to charter a company with a capital stock of \$25,000 to irrigate several thousand acres of land in that section. Work was begun December first. The plan, as outlined, does not interfere with the government's Red River project, as this land covers a territory adjacent to that project.

The Eldorado Irrigation and Farming Company of Eldorado, Okla., has filed articles of incorporation with the Secretary of State. Capital stock, \$5,500. Incorporators are Dr. T. A. Lowery, Frank Schultz, C. A. Boyd and J. E. Bodenhamer, all of Eldorado.

ON THE ROOF OF THE WORLD*

Recently I returned from a very long journey through the South American republics—a journey that consumed nine months of time and over 50,000 miles of travel. Leaving New Orleans on a fruit-carrying ship that voyaged along Central America, I arrived at Panama. After investigating the great canal, I sailed down the western coast of South America, going into the interior by rivers and railroads, and finally on board a vessel passed around the southern end of the continent through the Straits of Magellan, and then to the Falkland Islands in the Atlantic. Later I came by ship to Buenos Aires in Argentina, and went through that great country extensively, into Paraguay and Uruguay and on to Brazil, up the Atlantic coast, and finally to England, and from there to America. During this long journey I found no country more interesting than the high plateau regions of the Andes Mountains in South America.



Mr. Boyce on Shipboard.

continent is not surely known; some say from China, some say from a great island that lay in the Atlantic Ocean, which afterward sank into the sea; but, at any rate, they apparently found these high areas among the Andes the most pleasant and habitable. Here they developed a civilization the relics of which are surprising to travelers, and for years have been the study of scholars.

Volumes could be written about these vast highlands, but in this little Christmas souvenir I can only show you a few pictures I took in one or two of the old cities, and say a few things about their history.

I found Cuzco in Peru, the most picturesque, perhaps, of the towns of the high Andean regions. Bogota up in Colombia, Quito in Ecuador, LaPaz in Bolivia, are strange and wonderful old capital cities, built near the clouds, but Cuzco was the first capital of the Western Hemisphere and the seat of power of the ancient Incas, the great race of people that inhabited South America before the Spaniards came; hence it is particularly interesting.

From Lima, on the seacoast of Peru, I traveled to Cuzco by a wonderful railroad that climbs the Andean Range until one is over 16,000 feet above sea-level. This amazing railroad, which was engineered by an American, passes through sixty tunnels, one of which is 4,000 feet in length, and crosses awful chasms and twists and winds to and fro among the mountain peaks until one is carried

Commencing in Colombia, well up toward the Isthmus of Panama, these "hanging valleys" and broad open spaces of tillable land, sweep southward over 2,000 miles along the backbone of the Andean Range, through Ecuador, Peru, Bolivia, and down into western Argentina. This long, crooked, broken strip of country lying among the mountain tops, men have called the "roof of the world," certainly it is the "roof" of the South American continent. From whence the ancient race of people came who first inhabited the

above the clouds. Up in that strange country are some great copper mines; one, the Cerro de Pasco, being over 14,000 feet above sea level, and another mining camp, named Morococha, being 17,500 feet above the sea the highest point where men work anywhere in the world. American capitalists own these mines.

The scenery is very grand up in this high region, there being an eastern and western range of mountains, between which stretch the valleys and broad open spaces. Here through 2,000 miles of country, north and south, there are impressive evidences of a prehistoric race, in ruins of temples and old cities, the foundations of military roads that once were splendid highways, astonishing systems of terraces on the mountain sides, where men stored and tilled the soil, and many other remains of the skill and industry of a once powerful and enlightened people. In their burial mounds have been found pottery, gold and silver vessels, ornaments of rare carving, and cotton twine and woven cloth, denoting their expertness in manufacture.

They drilled with drills made of pure copper, having a method of tempering the metal until it was as hard as steel, a method that is unknown today, being numbered among the lost arts. They also built reservoirs, canals and irrigating ditches. They tolerated no leisure class, every one being obliged by law to work, the products being divided between the government, the priests and the people.

What is definitely known of the history of this people reaches back about 1,000 years. At that time there were several tribes of Indians inhabiting the high plateau about Cuzco, the old Inca capital, and from one of these tribes rose a great leader, named Manco Capac, who claimed descent from the Sun God. The word Inca means Lord, and Manco Capac was the first Inca, or king. After him his direct descendants ruled the vast Inca domains until the Spaniards came and conquered them.

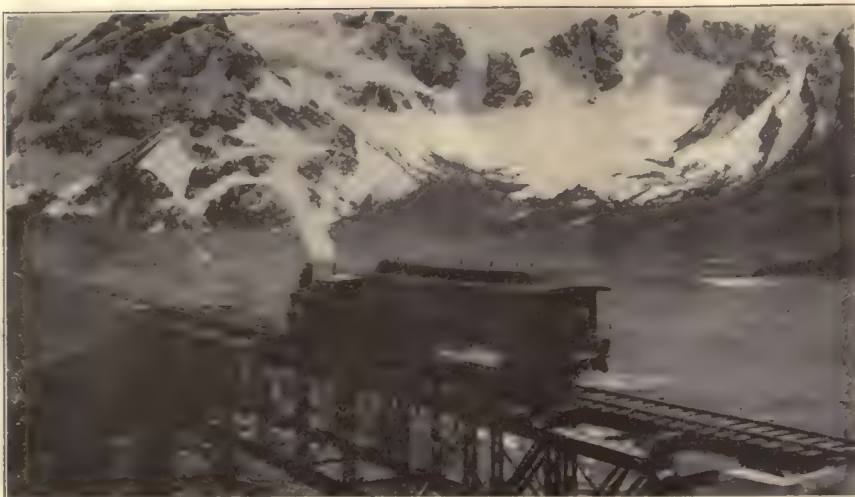
The Incas had numerous rich gold, silver and copper mines, and their wealth grew to be enormous. They were splendid fighters, and one by one they conquered the other Indian tribes of the great countries that are now Peru, northern Chile, northwestern Argentina, Bolivia, and Ecuador. Thus in time the Inca emperor ruled a vast area and was monarch of over 2,000,000 hard-working people. And, remember, these people were all Indians, building great churches and cities and doing innumerable skilful, clever things. The present Indian population of the countries stretching along the "roof" of South America are their descendants.

The basis of the religion of the ancient Incas was the worship of the sun; that is, the sun was the greatest visible evidence of God that they could see, so they worshiped it. Their architecture must have been very impressive. Their temples to the Sun God, and the palaces of the Inca Emperor, were constructed of huge stones so cut as to fit evenly one upon another, and the inside walls were treasure-houses of gold and silver, ornaments and decorations of precious stones. It is said that many of the Inca chiefs and persons of high estate ate from solid gold plates. At any rate, there was a very great deal of



Llamas and Street, La Paz, Bolivia.

*By W. D. Boyce, Chicago.



Mr. Boyce's Special Car in the Mountains.

gold among them, and it was this fact that led to their overthrow by the terrible Spaniards.

Atahualpa was the last emperor of the Incas. During the early part of his reign he was constantly at war with his brother, Huascar, who tried to usurp the throne. But Atahualpa, with his enormous resources and an army of 70,000 men, finally conquered his traitorous brother. At this time the Inca empire had reached its greatest expansion, including all of the habitable parts of Ecuador, Peru, and Bolivia, three-fourths of Chile and a large portion of Argentina, stretching nearly the entire length of the South American continent, and from the Pacific Ocean to the eastern foot of the Andes Mountains. The realm had reached the acme of its glory; then the Spaniards came. Everything would have turned out differently for the Incas, no doubt, had they possessed horses to ride and had they known of the uses of gunpowder. Their beasts of burden, however, were only llamas, a sort of large, long-necked species of sheep, and their implements of warfare were, for the most part, only such weapons as men use in fighting each other hand to hand. But explosive powder had been invented by the Chinese a long time before this, and finally it had been adapted to use in firearms in Europe, and the Spaniards, armed with this terribly destructive agent, were going about the little known regions of the world, gathering gold for their king and themselves by what was, in truth, force and robbery. In this way they conquered and looted all of South America.

It was in 1532 that word was brought to Atahualpa, the Inca king, that a small army of strange-looking men, who had white faces upon which grew hair, and who rode astride strange, big animals, had landed on the coast at Tumbez, down on the gulf of Guayaquil, Ecuador. This proved to be the beginning of the invasion under the leadership of the notorious Spanish adventurer, Pizarro. He had learned of the wealth of the Incas, and had been authorized by the king of Spain to conquer their kingdom, remitting to the royal treasury one-fifth of the gold he might get. Pizarro and his followers finally reached the great upper plateau and camped near a town called Cajamarca. The Inca emperor sent Pizarro a friendly message and asked if he might visit the Spanish camp. Pizarro granted the request, and when Atahualpa arrived, the Spaniards killed the emperor's body-guard and made him a prisoner. The Incas could not defend themselves, since the Spaniards wore coats of mail and shot the helpless Incas down with powder and bullets. The Inca emperor was imprisoned in a large room, which was closely guarded, while Pizarro proceeded to conquer the surrounding country, slaughtering great numbers of the people.

One day Atahualpa sent for Pizarro and said: "I will fill this room in which I am held prisoner with gold as high as I can reach,

if you will let me go free." Pizarro eagerly agreed, and gold was brought in by Atahualpa's faithful subjects until the tremendous ransom was complete, amounting, it is said, to about \$23,000,000 of modern money. One-fifth of this huge sum was sent to Spain and the remainder divided among Pizarro and his men, even those who received the smallest portion being made rich. Pizarro, as might have been expected—for he was one of the greatest robbers in human history—did not keep his word with the Inca emperor, and, instead of setting him at liberty, had him executed on the public square of Capamarca. During the confusion and panic that spread through the region following this awful deed, Pizarro marched to Cuzco, the capital, and captured it. After that, having received additional soldiers from Spain, the looting invaders swiftly conquered the various

Indian tribes throughout the Inca empire, and taking possession of the land, divided it up in large estates, compelling the Indians to pay tribute to the Spanish. Thus, through bloodshed and treachery, the great Inca empire was overcome and fell, and the invaders were left to fight among themselves over the land and spoils. And fight they did, each captain claiming more territory and riches than his fellows, and there was almost constant warfare in the country. Finally Pizarro himself was assassinated by jealous officers of the expedition. He had been appointed governor, and had established himself in Lima, where he lived surrounded by every luxury that gold could buy. There, one night while he was eating dinner in his palace, twenty of his treacherous followers rushed in and killed him, though he fought desperately to the last. However, the assassins gained nothing, for it chanced that Vaca de Castro, a royal commissioner from Spain, arrived in the midst of the confusion and the guilty ones were executed in the public square of Lima.

After that, through many years, one governor after another was appointed by the king of Spain to rule over the conquered country, despoiling it through pillage and taxes, and sending gold and riches to the treasury of Spain. Vice-captain-generals from Spain ruled in Argentina, Venezuela, Colombia, Ecuador and Bolivia, wringing money from the inhabitants for the Spanish crown. Finally the inevitable storm of revolution broke out all over South America. This was in 1806, and years and years of war and bloodshed followed. At last, under the chief leadership of General Simon Bolivar of Colombia and General San Martin of Argentina, after many great battles, the Spanish power was entirely broken and inde-



Cocoa Chewers.

pendence was won. This was in 1825, and after twenty years of struggle. Today each of the divisions of the vast area that first constituted the Inca empire, and afterward the Spanish dependencies, is a republic, with a government much like that of the United States. In truth, the example of the free states of North America was the inspiration that nerved Bolivar and San Martin and their followers through their long struggle for independence. Thus the mighty idea of liberty spread and grew, and has been spreading abroad in the world ever since.

As I rode through the streets of Lima, I thought of this history and what liberty had brought, for it is now a splendid city, and when I had been speeded to the cloud-land of the backbone of the Andes by a modern locomotive, and wandered through the strange old towns of the Spaniards and the Incas, I found that which accompanies liberty there—prosperity and progress transforming the country.

(To be continued in February.)

IRRIGATION WITH LAKE MUCK.

By C. R. Sandvig, Belgrade, Minn.

My horticultural experiments began in 1907 on a few acres purchased for that purpose on the lake shore near Belgrade. My motive was uncertain. Secretly I believed that by getting a centrifugal pump to pump the soft mud, so abundant in the lake bottom, to irrigate with during dry seasons the poor soil could be cheaply enriched and the effects of drought warded off. To the neighbors I explained that I could better afford to experiment than others, having no family to suffer in case the experiments should prove a failure and being profitably employed during the winter to supply my expenses, with nothing in particular to do during the summer.

My first strawberry crop was very poor indeed, but the plants had been set before my pump had been installed. They had been raised with thorough cultivation but had received none of that rich mud; nor had the patch been manured, as I was absent except during the planting and growing season. They had also suffered from drouth, and the year was an off year, so that failure was accounted for—but the next crop should be a bumper.

A generous patch was set in 1908, cultivated thoroughly and irrigated sufficiently with muck-laden water, and I engaged a neighbor to cover them well with hay after freezing, before leaving for my other employment. The following spring the whole patch had winter-killed. Seventy-two apple trees, eighty-four plum trees and 100 Compass cherries set the same spring had thrived splendidly with irrigation, while trees planted by neighbors were dying of drouth. Not one of my 256 perished, and they were all there the following spring, but as warm weather came many of the apple trees root-killed, though the Compass cherries and plum trees all lived and were changing the looks of the landscape. The losses, however, were beginning to wear that obnoxious question into my mind: "Would it pay?" Our soil is a poor black loam underlaid with gravel, and no fruit grower had come that way to blaze the way to success.

Dry weather again set in in the latter part of the summer of 1909. The man whose gasoline engine I had used the year before had moved away, and no engine could be hired. Threshermen would not consider hiring out their engines, and one flushed angrily when I tried to corner him by intimating that I would pay as much as he could make threshing though the threshing season was not there. Could it be that they had a prejudice against competing with nature? Three thousand five hundred cuttings planted for windbreak perished; the lower leaves of the golden willows were falling; the leaves in the orchard were fading and so was my enthusiasm. The pump was there but no power to turn it, and what a difference it made!

One Monday morning, the latter part of summer, I boarded the early morning train without a word of explanation to anybody. This was nothing new, but there was a reason for my silence this time, for though my destination was determined, my mission was rather novel and uncertain; and my neighbors seemed very much surprised and puzzled when, in the latter part of the week,

I returned before they knew I had been away, with a new suitcase on one arm and a bride on the other. Of course, that's another story—but it made a difference. On the same trip I had found a little steam engine, out of date for threshing, but to be repaired, tested and turned over in good order for a moderate sum. In due time it was brought to my little farm, but too late for that season as rain also began to fall.

I soon learned that my young bride had brought with her much besides what the new suitcase contained. I had planted and watered the year before two rows of golden willows for a windbreak. These were now a little higher than our heads, the rows just far enough apart for two and as golden as the sunset glow. My wife wrote in her letter home that we had a beautiful "lover's lane." She had brought a new name for the windbreak. The setting sun had smiled on those golden willows, and its smile had lingered there. My wife smiled on my little farm, and her smile changed it into home, sweet, sweet home—and the smile that changed it into home gave me new enthusiasm and determination.

We left as I again returned to my winter occupation, but March 18th—a winter month indeed—I was back impatient to renew my contest with nature, and spring was there just as soon. I had tried to describe to my wife how beautiful the place would appear in the springtime when the Compass cherries and plum trees would be robed in their perfumed whiteness and nature seemed impatient to show forth her beauty. The "lovers' lane" burst into leaves and looked like a beautiful sunrise. A hundred thrifty Compass cherries and eighty-four plum trees were just ready to unfold their glory, when lo! winter returned upon us, and those trees did not bloom—but my wife's smile was there instead, and I did not linger to ask, "would it pay?" but planted a generous garden and potatoes at fifteen cents a bushel to fill in the vacant places. Sixteen hundred strawberry plants set during the unnatural spring perished. The garden planter was pushed out over and between those rows and beans planted in their stead. We cultivated persistently and irrigated as often as we could find time. Our table was soon well supplied, and we had good things to sell. When I brought the green peas to town the hotel keeper's wife asked anxiously if we had any beans. I told her we would have some in due time. She begged me to bring her our whole crop. Gardens all about us were a failure, and even potatoes in many patches a total failure, on account of the severe drouth (1910).

Our half a row of beans planted for early use soon began to bear, and I brought some to the landlady. She took them at sixty cents a peck and begged me again to bring her the whole crop. The main patch began to bear, and I brought them by the bushels. She took them and looked pleased. The patch planted where the strawberries had perished began to bear, and I brought them by the load and reminded her that she had bargained for our whole crop, when she threw up her hands and exclaimed: "Oh, goodness gracious, I didn't think you would have so many," and then went to the telephone to call in her neighbors to help her out and told me it was enough. I brought in a load of potatoes and was heading four the hotel, our best customer, when men surrounded my wagon and bought me out before I could move, and they were a dollar a bushel potatoes too. And it just did me good to see those men, formerly so prejudiced against irrigation, pick up the big fellows smilingly and make comparisons with those on their own back lot and then remark: "That's what water does." "That's what irrigation does."

It should be needless to say that we have had much to learn and that for want of both time and experience we did not do as well as we might have done, and that there is a feeling of impatience to get back and try it again and try to do better. We pump 260 gallons a minute of muddy water with bullheads, clams, crabs, bloodsuckers and some gravel through 600 feet of pipes and several hundred feet of graded up ditch to the highest elevation and from there irrigate by running the mud-laden water in furrows ploughed between the rows. I think we water a patch in this way about as fast as it could be cultivated with one horse while the muck is

probably equivalent to the manure that could be hauled by two men with teams. It requires three to run the outfit. One to irrigate, one to run the engine (we burn straw) and one to operate the dredging arrangement and see that it draws mud.

It is not a question: "Will it pay?" though I am well pleased with the prospects, but on our light sandy soil we need to irrigate to make a home, and what is necessary to make a home is worthy of our time, money and most serious consideration.

Banker Views Conditions in Western States

By George B. Caldwell,

Manager Bond Department, Continental and Commercial Trust & Savings Bank, Chicago.

A visit to the distinctively western states at this time could not fail to be of interest and value to a Chicago business man. I have just had the pleasure of making a tour through important sections of Colorado, Utah and Idaho, where I was impressed with facts pertaining to the development of that part of the country.

General business is improving and is on a healthy and apparently normal basis. The feeling among financial men and others with whom I talked is one of cheerfulness, owing to the practical evidence that times are becoming better.

All development work is going forward at a good rate, real estate is moving, there are many new settlers and money is plentiful. This is particularly true of Colorado and Idaho. Utah is a rich and conservative state, showing solidity, but perhaps less activity than the others.

Western investments are attractive and eastern capital is going in freely. I took pains to observe the financial aspect of the situation. Land values are seemingly of a permanent character. Farming is on a progressive scale and returns are sufficient to justify the high price of irrigated land. These are all mining states also and results in the production of metals are quite satisfactory. These conditions, with high rates of interest, make the field an attractive one for capitalists.

The wide range of development work makes a constant demand for money at better rates than prevail in the surrounding states. Capital loaned with ordinary prudence is safe and brings a good return. In the Pueblo district and throughout the Arkansas Valley the common rate of interest on real estate is 7 to 8 per cent, mostly the latter figure, and ordinary commercial loans are usually at 10 to 12 per cent. Money can be obtained more cheaply in Utah, while in Idaho the outside figures are the prevailing ones on loans. Perhaps it would be nearer right to put real estate loans at 10 per cent and commercial accommodations at 12 per cent. Bonds naturally go east for their market, for no matter how good an article of security may be it is hard to sell a 6 or 7 per cent bond when money is in demand at 10 to 12 per cent.

These are conditions which strike a banker at the outset. They form an exceedingly interesting situation. In all new countries money rates are high, and that is the case very frequently because the risk is greater than in a section that is farther advanced. It is noticeable in the sections named that the loans are amply secured, because the development work is at a high stage. Everything is keyed up to that level. Farming seems more of a business proposition than in many other localities. Irrigated land sells commonly for \$150 to \$500 an acre, and the artificial water service only adds about \$25 an acre to the original price. This would seem an enormous price for farm land in some of the older states, but those

(Continued on page 115.)

Reclamation Notes

CALIFORNIA.

Articles of incorporation have been filed by the Pacific Water & Development Company, with principal place of business at Sacramento. The capital stock is \$500,000. The purpose of the company is to engage in and conduct the business of acquiring, using and selling water for irrigation, and for purposes of a public nature. The directors are F. H. Reynolds, A. C. Moor, D. K. Colchough, S. E. Quinn and N. V. Moor, all of Sacramento.

Announcement is made that \$350,000 of the first mortgage 6% bonds of the Sacramento Valley Irrigation Company have been paid and retired.

Ranchers in the vicinity of Oxnard have commenced \$25,000 worth of pumping and irrigation work. One of the largest pieces of work will be the placing of a pumping system and irrigation plant on the big Edwards ranch, which will be used for the irrigating of 700 acres of that property. The water is to be secured from artesian wells and pumped to various fields of the ranch.

Twelve thousand acres of land lying between Millville and Anderson are to be irrigated by water taken out of the south fork of Cow Creek.

Concrete work has been begun on the dam for the Oakdale and South San Joaquin irrigation districts on the Stanislaus river, four miles above Knights Ferry. The structure is to be 84 feet high at the highest point. It will divide the Stanislaus river into two canals which will irrigate the plains around Oakdale, Ripon and Stockton, in all about 139,000 acres.

A plan to irrigate a vast section of the Hesperia regions is under way. A general consolidation of the water rights in that district has been effected under the name of the Appleton Land and Water Company. This land lies adjacent to the town of Hesperia and when water is applied will be highly productive.

The Hallwood Irrigation Company and the Stahl Brothers have received a permit from the United States government to build an intake at Daguerre point which will enable them to take water from the Yuba river at all seasons of the year. The work must be completed by November 3, 1912. The capacity of the tunnel, which will be concrete lined, will be about 7,000 miners inches of water, or enough to irrigate 10,000 acres of land.

It is reported that between 500,000 and 1,000,000 acres of land, much of it lying near the city of Oroville, will be irrigated by water from the Big Meadows Reservoir of the Great Western Power Company. M. Fleishacker, president of the G. W. Power Company, is authority for the statement. This will not only serve to supply irrigation and power for a large area, but it will also serve to decrease the flood waters which now run to waste through the valley.

COLORADO.

The Northern Construction Company has been organized by Denver and Greeley capitalists to finish the ditches and reservoirs in the Greeley-Poudre Valley irrigation district by May 1st. It is planned to bring water to every portion of the district except the river reservoir. The project embraces about 125,000 acres of land. Those interested are James Thorpse, W. S. Hill, J. A. Beeler, Wm. G. Evans and S. D. Shields, all of Denver, and D. A. Camfield of Greeley.

Eastern capitalists, headed by J. H. Holmes as president, J. S. Stovall, secretary, and B. R. Holmes, general manager, have purchased the ranches of Geo. Hotz, Ben Hotz and John McLain, just north of Carbondale, for a

reservoir site. The reservoir will have a capacity sufficient to irrigate 20,000 acres of land. The principal office of the Carbondale Reservoir and Irrigation Company is located at 801 Continental bldg., Denver, Colo.

T. D. Nowles of Lamar, J. S. Hasty of Lamar, Donald McIntosh, Las Animas, C. D. Ray, Wiley, John O'Neill, La Junta, were elected directors of the Fort Lyon Canal Company at a recent meeting.

It is reported that 200,000 acres of land lying near the town of Saguache is to be brought under irrigation. T. C. Henry of Denver has proposed that this land be brought under an irrigation district and be irrigated from waters stored in an immense reservoir to be constructed on the headwaters of the Rio Grande river at Antelope Park. The proposed reservoir will impound about 250,000 acre feet of water.

An irrigation project that plans to reclaim 100,000 acres of land in San Miguel and Montrose counties has been launched, entailing an expense of \$4,000,000. General Bulkeley Wells of Telluride, Duncan Chisholm of Colorado Springs, Chaloner Schley of Colorado Springs, and Robert McF. Doble of Denver are the promoters. About 43,000 acres of Carey Act land under the supervision of the state land board are to be included in the tract to be irrigated, and a segregation of this amount of land has already been ordered by the board. The other 57,000 acres will be purchased outright. Water to irrigate this vast area will be taken from the San Miguel river near Placerville, and also from the watershed of the Lone Cone.

A finished survey has been made of the Buck and Weisdorfer Irrigation system whereby 23,000 acres of choice land in north central Kiowa county will be irrigated. The head works will be located on Rush creek near the Lincoln and Cheyenne county line about fifteen miles north of Haswell. It will obtain its supply from twenty-three immense wells and two submerged tunnels tapping the underflow.

The United States government has begun suit in the federal court against the Henrylyn Irrigation District Company to prevent that concern from building its projected tunnel and canals through the Arapahoe and Pike national forest reserves.

The Home Supply Ditch and Reservoir Company held its annual meeting in Loveland late in December. During the past ten years an indebtedness of \$40,000 has been lifted by this company and more than \$40,000 worth of new work has been added to the property.

Through a decision of the Colorado supreme court in the case of the Welden Valley Ditch Company of Morgan county against the Farmers-Pawnee canal company of Logan county, the ditches in Morgan county will gain 56.6 feet of water, valued at nearly \$170,000.

The Secretary of the Interior has authorized the Director of the Reclamation Service to execute contract with the Saylor Construction Company of Lamar, Colo., for the construction and enlargement of Divisions 6 and 8 of the East canal, Uncompahgre irrigation project, Colorado. The work involves the excavation of 81,000 cubic yards of material; the contract price is \$18,060.

OREGON.

At a meeting of the incorporators of the Central Oregon Pioneer & Irrigation Company held in Baker recently, the following officers were elected: W. A. Pope, president; S. S. Start, vice-president; C. T. Goodwin, secretary, and Mrs. Blanche Rhineart, treasurer. The company plans the reclamation of 40,000 acres of land in Malheur county, which will require an expenditure of approximately \$150,000. The construction work will be commenced immediately.

John Zalinsky, a German farmer living near Chemawa, has erected a tower and tank above a drilled well of over

100 feet depth to be used for irrigation next season, the pump to be operated by a gasoline engine. This is the first attempt at irrigation in this section and is being closely watched.

The irrigation project near Laidlaw has been taken up by the Columbia Southern Irrigating Company. The company has filed its deed, maps, etc., and will have sixty more days, according to its contract, in which to show the Land Board that the project will be satisfactorily financed. At the end of that time, if plans for financing the project are not successful, further operations will be suspended.

A hearing which will have an important bearing on the future of the Central Oregon Irrigation Company, which is the reorganization of the Deschutes Irrigation and Power Company, will be held in the near future before the Desert Land Board of Oregon. Settlers in the Deschutes valley have made complaints that the company is not furnishing sufficient water for the lands under cultivation; that it is not taking steps to complete its north canal, etc.

MISCELLANEOUS.

R. D. Yoakum of St. Louis, Mo., has installed a pumping plant on his ranch near Sante Fe, New Mexico. The plant includes a 50 h. p. oil engine capable of handling 2,000 gallons per minute. This is the largest individual pumping plant ever installed in the Portales valley.

The greatest Carey Act project in the United States, embracing 240,000 acres of land in the Green River valley, Utah, has been financed by Denver, Colo., capitalists. A. W. Hille, A. L. Briggs, J. A. Simpson and H. G. Wilson, all of Denver, are backing the project. The plans of the company contemplate the damming of the Green river, which flows through the tract. This dam will be built in a natural reservoir site at a point where the river passes through a narrow gorge. This will give the drop necessary for carrying the water through the 337 miles of canals that have already been surveyed. While the company has not yet definitely decided on the price that will be asked for the water, it is stated officially that it will not exceed \$100 per acre.

Within the next sixty days the South Willow Irrigation Company of Grantsville, Utah, will probably commence work on improvements on their present irrigation system, which will cost about \$70,000. The present system of cement piping which conveys the water from South Willow canyon to the farms in the valley will be torn up and replaced with steel pipe.

C. A. Laird of Howe, Idaho, and other settlers under the ditch system of the Blaine County Irrigation Company, have brought suit against that company for its failure to deliver water for the season of 1910. They claim \$80,000 damages.

The improvements on the Carlsbad irrigation project in New Mexico are being rapidly pushed to completion. At McMillan, the upper reservoir, the embankments will be raised four feet, increasing the capacity of the reservoir 30,000 acre feet, making the total capacity over 60,000 acre feet. The estimated cost of the improvements now under way is \$75,000.

The Secretary of the Interior has directed the Reclamation Service to accept a contract with T. C. Eggleston of Denver, Colo., for furnishing two 21-foot diameter cylinder gates for use in connection with the Avalon dam, Carlsbad irrigation project, New Mexico. The estimated value of the contract is \$4,525.

Contract has been awarded to Marcus E. Getter of Mitchell, Neb., for enlarging the parts of lateral 24 of the North Platte irrigation project, Nebraska-Wyoming. The total yardage involved is 14,000 and the estimated cost of the work is \$1,412.74. The work is to be completed by March 31, 1912.

Supreme Court Decisions

Irrigation Cases

IRRIGATION CANAL NOT A NUISANCE—

Where a canal has been constructed and operated in accordance with law, it is not a nuisance, and can only become a nuisance by reason of the manner in which it is maintained, or the method of its operation; and the mere fact that a municipality subsequently extends a street across a canal which has been lawfully constructed and operated does not convert the canal into a nuisance at the place where the street crosses the canal.—*Boise City v. Boise City Canal Co.*, Supreme Court of Idaho, 115 Pacific 505.

RIGHT TO WASTE WATER—

Where plaintiff's rights were limited and only attached to waste water discharged from a lateral irrigation ditch, she had no control over the ditches or laterals, or the water flowing therein, nor were defendants obligated to continue or maintain conditions so as to supply plaintiff's appropriation of waste water at any time or in any quantity, provided they acted in good faith.—*Green Valley Ditch Co. v. Schneider*, Supreme Court of Colorado, 115 Pacific 705.

DUTY OF WATER—

Where the evidence shows the average duty of water under a canal to be five-sevenths of an inch to the acre, a judgment awarding over seven-eighths of an inch is erroneous, in the absence of any testimony establishing a lower duty of water on that particular tract.—*Gerber v. Nampa & Meridian Irr. Dist.*, Supreme Court of Idaho, 116 Pacific 104.

IRRIGATION CONTRACT—

Thirteen years' acquiescence in practical construction given a contract to supply water for irrigation estops a consuming company to claim a larger quantity than has been furnished, especially where large and flourishing communities have been built up at great expense under such construction.—*North Fork Water Co. v. Medland*, U. S. Circuit Court, southern District of California, 187 Federal 163.

RIGHTS OF LOT OWNERS.

Lot owners in a city who have become entitled to the use of water from an irrigation system cannot be compelled to pay for the company's system, nor can they be denied water for the reason that its delivery has been made more expensive or more burdensome to the company.—*City of Nampa v. Nampa & Meridian Irr. Dist.*, Supreme Court of Idaho, 115 Pacific 979.

DETERMINATION OF WATER RIGHTS—

Under the rule that equity aims to settle in a single suit the rights of all the persons interested in the subject-matter, it is important that all claimants to the right to divert the waters of a natural stream for beneficial purposes shall be brought into the same court in a single action and therein required to wage their claims, so that such claims necessarily more or less interdependent and conditioned on one another may be settled by a single decree.—*Washington State Sugar Co. v. Sheppard*, U. S. Circuit Court, District of Idaho, 186 Federal 233.

OBSTRUCTION OF STREAM—

A riparian owner upon any of the streams of this state, whether navigable or nonnavigable, takes to the thread of the stream (citing *Johnson v. Johnson*, 14 Idaho 561, 95 Pac. 499, 24 L. R. A. [N. S.] 1240, and *Lattig v. Scott*, 17 Idaho 506, 107 Pac. 47), and may maintain an action for an obstruction in such stream which diverts the stream or a portion thereof from its natural course, to his damage.—*Fischer v. Davis*, Supreme Court of Idaho, 116 Pacific 412.

WATER RIGHT "REAL PROPERTY"—

Under the laws of this state, a water right is "real property," and one who has actually diverted the water of a stream and applied the same to a beneficial use is in the actual possession of such real property, and this possession constitutes actual notice to any subsequent appropriator of the water of the same stream, or to any person who subsequently applies to the state engineer for a permit to appropriate and divert the water of the same stream.—*Nielson v. Parker*, Supreme Court of Idaho, 115 Pacific 488.

BRIDGES—

In the absence of statute, a canal constructed across a highway must not interfere with the use of the highway, and a highway constructed across a canal may not interfere with

the use of the canal, and hence the public, in the latter case, must bear the expense of building the bridge; the reason being that the acquisition of a subsequent easement does not carry with it the right to injure or destroy a prior one.—*City of Madera v. Madera Canal & Irrigation Co.*, Supreme Court of California, 115 Pacific 936.

EXTENSION OF DITCH—

Defendant secured a right to construct an irrigation ditch through certain land when it was largely vacant and unoccupied. For many years the ditch owners did not attempt to utilize any land on either side of the ditch between the points in controversy, and 15 years after its construction and while such conditions continued, the owners of the adjoining land platted the same into lots and blocks, and caused it to become a part of a city. Some of the plaintiffs purchased the lots, and placed improvements thereon, with defendant's full knowledge, and others purchased lots with improvements thereon. Held, that defendant was estopped to claim a right to improve the ditch by widening it to the injury of such improvements.—*Arthur Irr. Co. v. Strayer*, Supreme Court of Colorado, 115 Pacific 724.

CONVEYANCE OF WATER—

Where, after riparian proprietors had conveyed land to K., with the right to divert the waters of a stream for irrigation and mill privileges, K. joined with his grantors and others who were complainant's predecessors in title in building head gates and dams and reconstructing a ditch subsequently conveyed to complainants, whereby the water was taken upon and made appurtenant, not only to their lands, but also to lands of K. on the west side of the river, which he afterwards conveyed to complainant A., with all the tenements, hereditaments and appurtenances thereunto belonging or in any wise appertaining, there being at that time sufficient water for users on both sides of river, K. and his grantees were estopped by a subsequent increase of their use to deny the validity of complainants' appropriation.—*Andrews v. Donnelly*, Supreme Court of Oregon, 116 Pacific 569.

ARBITRARY REGULATIONS—

Since the obligations of a private corporation organized to sell arid lands and furnish water for their irrigation are quasi public, such company cannot impose arbitrary restrictions upon the supply of water under the guise of regulations.—*Shafford v. White Bluffs Land & Irrigation Co.*, Supreme Court of Washington, 114 Pacific 883.

PRESCRIPTIVE RIGHT TO WATER—

In order to support a prescriptive right to take water from a stream at a point on another's land, the claimant must show that they have taken some definite quantity of water therefrom in the past; it being insufficient merely to show that they have taken some water.—*Logan v. Guichard*, Supreme Court of California, 114 Pacific 989.

REASONABLE WATER RENT—

Where defendant agreed to pay a "reasonable rent" for water to be furnished him each year for irrigating purposes, there is no such ambiguity as to permit parol testimony that "reasonable rent" meant one-fifth of the crop.—*Old River Rice Irr. Co. v. Stubbs*, Court of Civil Appeals of Texas, 137 Southwestern 154.

DEDICATION OF WATER—

Evidence showing the use of drain or waste water, or water primarily belonging to a prior consumer under a canal system, does not establish a dedication of water direct from the canal to the lands of such user.—*Gerber v. Nampa & Meridian Irr. Dist.*, Supreme Court of Idaho, 116 Pacific 104.

WATER RIGHTS—

A deed conveyed a system of water ditches, and "such right to use the water of K. river in said ditches as" the grantor "now possess," and further provided that there was "saved and reserved" from the operation of the conveyance so much of the water now owned by the grantor as would enable it to fulfill any contracts for the supply of water which it had theretofore made, and the grantee covenanted to keep the ditches in such repair as would enable the grantor to perform the services required by such contracts. Held, that there was no transfer of any water rights to which others were there entitled under contract with the grantor.—*Abbott v. Land & Water Co.*, Supreme Court of California, 118 Pacific 425.

SECRET BALLOT APPLIES TO IRRIGATION DISTRICT—

Section 1, art. 6, Const., which provides for a secret ballot, is applicable to elections held in an irrigation district under the laws of the state.—*Pioneer Irr. Dist. v. Walker*, Supreme Court of Idaho, 119 Pacific 304.

THE NATIONAL DRAINAGE CONGRESS.

During the meeting of Nineteenth National Irrigation Congress last December in Chicago, a call was issued to those who were interested in the reclamation of swamp and overflow lands for the purpose of organizing a National Drainage Congress. Mr. Edmond T. Perkins, president of the American Reclamation Federation, issued the call and acted as chairman during the preliminary meetings. As the body thus newly organized will undoubtedly become an important factor in national reclamation, the new constitution adopted by it is herewith given in full.

Constitution.

Article I—Name.

This Congress shall be known as the National Drainage Congress.

Article II—Objects.

The objects of the Congress shall be (1) to promote and to diffuse knowledge concerning the reclamation of lands in all those states of the Union where drainage reclamation would be beneficial, and also concerning the artificial application of water to lands requiring irrigation in such regions; (2) to promote navigation by means of canals built for drainage and by improvements of the natural streams into which such canals are discharged; (3) to conserve and impound water for drainage, humid-land irrigation, or flood protection purposes; (4) to conserve and control natural resources pertaining to agriculture; (5) to restore and preserve soils by rotation, fertilization, and overflow of silt; (6) to remove the menace to the public health of the Nation which the presence of undrained lowlands constitutes; (7) to facilitate conference and deliberation among the people of the country concerning drainage and related interests, especially to promote agreement and concerted action among those organizations interested in the conservation and proper utilization of our natural resources to the end that united efforts may be towards agreed-upon ultimate results; and (8) to provide means for bringing the needs of the people and the country before State and Federal governments.

Article III—Limitations.

This Congress shall not at any time engage, commercially or otherwise, in the promotion, exploitation, or exhibition of individual projects except as may be necessary for the purposes of illustrating the need for or the benefits of drainage, or humid-land reclamation, nor engage in the sale of land, water rights, bonds, stock, or other evidence of ownership or interest in property; nor shall it promote, endorse, or advertise any individual, corporation, project, scheme, or locality, except as above provided.

Its scope shall embrace a broad, unbiased, and comprehensive consideration of the objects as herein set forth, from a national viewpoint, for the good of the entire commonwealth and that of agriculture in particular. It shall have no political affiliations nor permit political matters to enter into its business or discussions other than those which shall pertain to the objects of the Congress.

Article IV—Meetings.

Section 1. Regular annual sessions shall be held at such places as the Congress shall determine and at times set by the Board of Control and approved by the Executive Committee.

Section 2. Special meetings of the Congress, or of its officers, boards, and committees, may be held at times and places determined by the Congress or the Executive Committee.

Article V—General Officers.

Section 1. The officers of the Congress shall consist of a President; five Vice-Presidents, each of whom shall be resident in different states, and a Treasurer elected as hereinafter specified. The duties of these officers may at any time be prescribed by the Congress or the Executive Committee. In the absence of such action their duties shall be those implied by their designation and established by custom.

Section 2. The officers shall serve for one year, or until their successors are elected; provided, that the

President and Treasurer shall not be relieved before the close of a regular annual session except by vote of the Congress, or action of the Executive Committee, which action shall not be taken except for cause.

Article VI—Committees.

Section 1. There shall be an Executive Committee comprising one member from each state, selected by the delegation thereof, and of the General Officers provided in Article V. The term of office of one-third of the Executive Committee, not including the General Officers, to cover one year from the time of the Second Annual Congress; the term of office of one-third of the Executive Committee, not including the General Officers, to cover two years from the time of the Second Annual Congress; and the term of office of one-third of the Executive Committee, not including the General Officers, to cover three years from the time of the Second Annual Congress; and the group of states that shall have representation on the Executive Committee for one, two or three years, as the case may be, to be decided by lot at the first meeting of the Executive Committee at the Second Annual Congress—thereafter, upon expiration of these terms, election for their successors to be for three years. This Committee shall act for the Congress between sessions, one-half of the members of the Committee present constituting a quorum; shall have power to direct the affairs, policies and activities, and to initiate plans and meet emergencies, and shall report to the Congress on the opening day of each session.

All ex-Presidents of the Congress shall be ex-officio members of the Executive Committee.

The President of the Congress shall act in a similar capacity for and on behalf of the Executive Committee and shall have power to call special meetings of the Executive Committee.

The Executive Committee shall have power to fill vacancies in its own membership and among the officers of the Congress, may make by-laws and rules to govern its own procedure, and may maintain a permanent office. It shall not incur nor authorize the incurrence by any of its officers or subordinates of any debts beyond available funds.

Section 2. The Executive Committee shall designate and appoint a qualified person who shall direct the work of the Congress, and who shall act as executive officer of the Committee, with the title of Director. He shall also serve, under the direction of the Committee, as Secretary of the Congress, and shall administer the activities of the Congress between its annual sessions, disseminate information to the members and the correspondents, and in all ways approved and authorized by the said Committee, promote the objects of the Congress. His compensation and allowance shall be fixed by the Executive Committee, and when appointed he shall serve for a term of two years, unless sooner removed for cause by the Executive Committee. The Director shall furnish sureties satisfactory to the said Committee in a sum equal to twice that placed to his credit at any one time by the Committee for the prosecution of work duly authorized. He shall report to the Executive Committee at regular sessions, and whenever directed to do so by the President or a majority of the members of the Executive Committee.

Section 3. A local committee, to be known as the Board of Control, shall be created in each city in which the next ensuing session of the Congress is to be held, preferably by the leading commercial bodies or business organizations; though in the absence of such local action, or in the event of failure on the part of such Board of Control to meet the financial and other requirements of the Executive Committee within sixty days after the adjournment of the preceding session, another place of meeting may be selected by the Executive Committee in lieu of that chosen by the Congress. The Board of Control shall have power to initiate action in conformity with the objects of the Congress, to raise and expend funds, to incur obligations on its own responsibility, to appoint sub-committees, and to conduct correspondence in its own name, either independently or in conjunction with the Executive Committee; and it shall report to the Executive Committee on the day before the opening

of the ensuing session, and at such other times as the Congress or the Executive Committee may direct. The Director of the Congress shall, ex-officio, be a member of the Board of Control.

Section 4. A Committee on Credentials shall be organized on the first day of each session of the Congress. It shall consist of one member from each state chosen by the delegation thereof. A temporary chairman shall be appointed by the President. Accepting the record of the Secretary as prima facie evidence of the organization of the Congress and of the rights of delegates and members, the Committee shall elect its Chairman and Secretary and shall adjudicate all questions relating to credentials and delegates. It shall report to the Congress from time to time, and shall submit its final report at the earliest possible date and in any event before the Congress proceeds to the adoption of formal resolutions, the selection of the next place of meeting, or the election of officers.

Section 5. A Committee on Resolutions shall be created for each session of the Congress. A temporary chairman shall be appointed by the President, one member shall be selected by each state delegation, and two members-at-large shall be designated by the President and a like number by the Board of Control. The Committee shall elect its Chairman and Secretary and shall report to the Congress not later than the morning of the last day of each session.

Section 6. A Committee on Permanent Organization shall be created during each session of the Congress in the manner provided for the creation of the Committee on Resolutions. It shall nominate officers for the ensuing year, its nominations being presented to the Congress in session, and may recommend administrative policies; and it may make other recommendations looking toward the public welfare or the interests of the National Drainage Congress.

Section 7.—By direction of the Congress, standing and special committees may be appointed by the President.

Section 8. The President shall be a member, ex-officio, of every committee of the Congress.

Article VII—Arrangements for Sessions.

Section 1. Invitations from cities desirous of entertaining the Congress at regular sessions shall be brought before the Congress for action either directly or on recommendation of the Committee on Permanent Organization.

Section 2. To be acceptable, invitations to the Congress from cities desirous of entertaining it must be accompanied by information as to their facilities and by a guarantee fund satisfactory to the Congress or Executive Committee.

Section 3. Meeting places shall be provided and hotel accommodations and other facilities arranged by the Board of Control.

Section 4. The program for the sessions, including a list of speakers, shall be arranged by the Executive Committee, unless the preparation of program be entrusted by that Committee to the Board of Control. The entire program, including allotments of time to speakers and hours for daily sessions, shall be referred to the Executive Committee for ratification not later than the day before the opening of each session of the Congress.

Section 5. Unless otherwise ordered the rules adopted for the guidance of the preceding annual sessions of the Congress shall continue in force.

Article VIII—Membership.

Section 1.—The membership of the Congress shall consist of (1) fifteen delegates from each state, to be appointed by the Governor thereof; (2) ten delegates from each city having a population of over twenty-five thousand, to be appointed by the Mayor; (3) five delegates from each city and town having a population less than twenty-five thousand and over one thousand, to be appointed by the Mayor or chief executive; (4) five delegates from each county, to be appointed by the Chairman of the governing board; (5) two delegates from each incorporated town having a population of less than one thousand; from each regularly organized asso-

ciation devoted to drainage, irrigation, or other reclamation work, agriculture, horticulture, and engineering; and from each college and commercial body concerned with public interests which has been duly organized not less than one year; (6) all duly accredited members of State and Federal drainage, irrigation, water, or conservation commissions; (7) all State engineers and State commissioners of agriculture and horticulture; (8) all officers, chairmen of committees, members of the Executive Committee, Honorary Vice-Presidents, members of the Board of Control, and permanent delegates of the Congress; (9) the Governor of each State, and the Mayor of each city and town having a population of over one thousand; (10) the President of the United States and all members of his cabinet, and (11) all members of the United States Senate and House of Representatives.

Section 2. The Executive Committee is authorized to create various forms of membership which may be State Organizations specified in Section 1, to be affiliated with the National Congress, or may be individual memberships, permanent, sustaining, or auxiliary, with fees and conditions of membership as may be established by the Executive Committee.

Section 3. Throughout each session of the Congress the Director shall keep a list of the duly accredited delegates, and shall hold the same open to examination or subject to the call of the Congress; and such list shall be subject to appeal to and action by the Credentials Committee. In the absence of appeal, or after such action and approval by the Congress, this list together with the roll of permanent members attending shall constitute the membership of the body for that session.

Article IX—Delegations and State Officers.

Section 1. The several delegates from each state in attendance at any annual meeting shall assemble at the earliest practicable time and organize by choosing a chairman, a secretary and a member of the Committee on Credentials; and these delegates when approved by the Committee on Credentials shall constitute the delegation from that state, which shall also appoint one member of each of the Committee on Permanent Organization and on Resolutions and in the absence of the member of the Executive Committee for any State at the time of the opening of the Congress, the delegation of that State may select a substitute.

Section 2. In addition to the members of committees provided for in Section 1, each State delegation may appoint an Honorary Vice-President to serve until the time of the next annual meeting, or in the event of there being no delegation from any State the Vice-President for that State may be appointed by the President of the Congress.

Article X—Voting.

Section 1. Each member and delegate present at the sessions of the Congress shall be entitled to one vote on all actions taken viva voce and a majority vote shall elect all officers and decide all questions.

Section 2. A division may be demanded on any action by a State delegation or a ballot by an apparent majority of the delegates present; on division or ballot each member and delegate shall be entitled to one vote; provided (1) that no State shall have more than twenty votes; provided (2) that when a State is represented by less than ten delegates and members, said delegates and members, if all present, may cast ten votes for such State, and provided (3) that if a part of the delegation of such State are absent, those remaining may cast their pro rata of ten votes; provided that such division shall be stated in whole numbers.

Section 3. The term "State" as used herein is to be construed to mean either state, territory or insular possession.

Article XI—Amendments.

This constitution may be amended by a two-thirds vote of the members and delegates present during any regular session, provided notice of the proposed amendment has been given from the Chair not less than one day or more than two days preceding; or by unanimous vote without such action.

The National Drainage Congress will hold its Second

Annual Convention in New Orleans, La., April 10 to 13, 1912.

Mr. Edmund T. Perkins of Chicago is First Vice-President and acting President of the Congress.

USELESS LAND MADE PRODUCTIVE.

The reclamation of vast tracts of arid land in the West and Southwest by means of irrigation as well the reclamation by drainage of other vast tracts, swamp and overflowed land in other sections form one of the most interesting epochs in the agricultural development of the United States.

Everyone is now more or less familiar with the magnitude of these reclamation projects and knows, in a general way that millions of acres of what was once useless land are now fertile fields of almost unlimited productiveness.

Few are aware, however, that on thousands of farms in every section of the country there are comparatively small tracts consisting of but a few acres, which because of their supposed uselessness, lie idle and unproductive year after year, the owners evidently taking it for granted that it would be a waste of time and labor to attempt to bring them under cultivation. But would such efforts be a waste of time and labor? Many farmers and land owners who have gone to work intelligently in the reclamation of the hilly, arid or swampy areas of their farms have found that it pays big dividends not only in the increased productiveness of the land, but in increased value of their farms as well. Such work is now simplified by means of a scientific instrument manufactured by the Bostrom-Brady Manufacturing Co., of Atlanta, Ga.

This instrument is called the Bostrom Improved Farm Level. By means of it any farmer can quickly obtain the exact "fall" required for any terracing, irrigating or draining work needed on his farm without the assistance of a civil engineer. Those who have used this extremely practical instrument say that it soon pays for itself many times over. The Bostrom-Brady firm has recently issued a most valuable and interesting book called "Soil Salvation" a copy of which, together with full particulars of their Farm Level, will be sent free to anyone interested on request.

CORRESPONDENCE

VERY INTERESTING INFORMATION.

The Editor,

IRRIGATION AGE,

Chicago, Ill.

Dear Sir: I beg to enclose herewith copy of a pamphlet which I have prepared on the "Indirect Benefits of Sugar Beet Culture," in which I have undertaken to show the effect of sugar beet culture in increasing the yield of all other crops, by reason of its general improvement of the soil and the adoption scientific and intensive farming methods which it requires.

Due primarily to the introduction of sugar beet culture, Germany, during the past 25 years, has increased her average yield of wheat, rye, barely oats and potatoes 13.2 bushels per acre, while during the same period the increase in yield of the same crops in the United States has been but 4.6 bushels per acre, the increase alone in Germany exceeding our present total average yield of these crops by 6.4 bushels per acre.

If from our present acreage of these five crops, we harvested as many bushels per acre as does Germany, it would add \$1,400,000,000 annually to our national wealth, while if Germany secured only our average yield per acre, her national wealth would be decreased \$900,000,000 a year.

Possessing, as we do, the finest agricultural conditions in the world, coupled with superior intelligence and greater wealth in our agricultural communities, I feel that the cause of this startling contrast is worthy of the most careful consideration of all patriotic Americans, especially those engaged directly in agricultural pursuits, as well as those who are indirectly interested in the subject.

You are at liberty to use any or all the data contained in the enclosed pamphlet.

Very truly yours

TRUMAN G. PALMER.

Plow Without Leaving Ridges or Dead-Furrows.

The JOHN DEERE Two-Way Sulky Plow Best for Irrigated Lands, Sidehill Plowing, or in Dry Farming Sections

Here is a plow that leaves no dead furrows to fill up—no back furrows to drag down.

Start on one side, plow back and forth, finishing up on the other side—field left level.

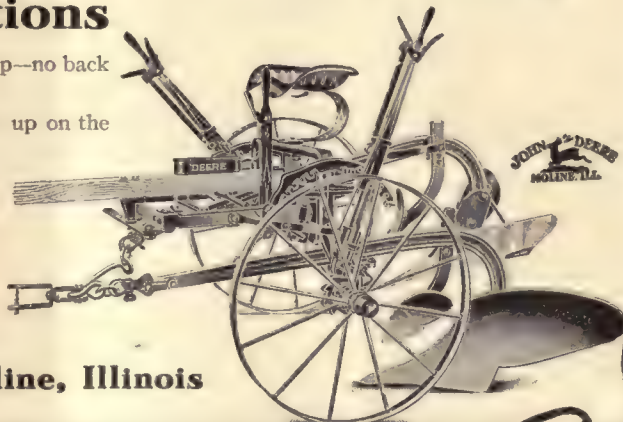
You can follow right after the plow with harrowing and seeding—no centers to plow out.

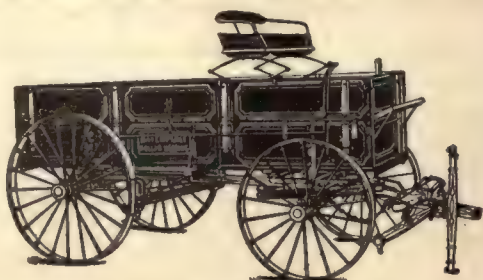
You can throw the dirt all one way on a side hill or plow irregular fields with no short "lands" to finish.

Lasts as long as two plows.

Write for booklet—free if you mention *Irrigation Age*

John Deere Plow Co., - Moline, Illinois





The Modern Wagon

BUILT OF STEEL

The only equipment that will stand the climate of the irrigated district, is made of steel. You know the reason. Wood dries out, becomes useless, and the machinery falls apart.

Davenport Roller-Bearing Steel Wagons

are THE wagons for the "Dry Farming" country. Not affected by the climate. Stronger, lighter draft and more durable; outlast several wooden wagons.

Built of steel I-beams, Channels and Angles, solidly riveted with large steel rivets, put in hot, making the gear parts practically one piece.

Nothing to Dry Out

No bolts to become loose and nuts to rattle off on account of parts shrinking or drying out. The DAVENPORT is constructed like the modern steel railroad bridge. Trussed and braced to withstand all strains. Built for the heaviest lifetime service.

No Tires to Reset

It makes no difference what the climate is, it does not affect the wheels on the DAVENPORT. They are made with a tension, each spoke carrying its share of the load all the time, whether it is on the top, bottom or side of the wheel. The spoke heads are countersunk in the tire; headed and shouldered in the hubs. The strongest wheels ever put on a wagon. No split felloes or cracked hubs. No repair bills to pay.

Roller Bearings



The Roller Bearing

30% to 50% Lighter Draft

It is a fact, that if it were not for the ROLLER BEARINGS, the automobile of today would be impossible. You know that ROLLER BEARINGS reduce the draft on machinery of all kinds. Here is your chance to get these advantages on

FARM WAGONS

TEAMING GEARS

MOUNTAIN WAGONS

LUMBER GEARS

TURN-UNDER WAGONS

Write NOW for all the information. Improve your farm by being able to do more work with the same horses and help. BE SURE and ask for PACKAGE NO. 45.

Davenport Wagon Company, Davenport, Iowa.

GOOD WORDS FROM CANADA.

EDITOR IRRIGATION AGE:-
Chicago, Ill.

Dears Sir: I have subscribed to your Journal some two months ago, and have intended writing you my appreciation of it. I think it is splendid paper for the practical man.

I notice you advertise your Primer of Hydraulics with each new subscription, I would greatly like to have a copy of it, and would like to know if I can take advantage of your offer. I subscribed for your Journal on the recommendation of Mr. Drake, Superintendent of Irrigation, Department of Interior, and had not seen a copy before I wrote you. Hoping to hear from you at your convenience, I beg to remain

Yours very truly,
A. W. ROGER.

MISCELLANEOUS NOTES

The farmers and merchants of Ness county, Kansas, are planning to install a complete irrigation system to irrigate a large portion of the area of the county. The plan is to sink a number of wells in the vicinity of Utica, from which water for irrigation purposes will be pumped by crude oil engines.

Twenty-five farmers living in the Otter Creek valley, west of Mountain Park, Okla., are preparing to charter a company with a capital stock of \$25,000 to irrigate several thousand acres of valuable land.

Headed by F. A. Hornbeck, land commissioner of the Kansas City, Mexico & Orient Railway, a syndicate composed of Kansas City capitalists has purchased 41,000 acres of land in Pecos, Brewster and Jeff Davis counties. A steel reinforced concrete dam, 1,800 feet long, will be erected across the mouth of the canyon on the property, forming a reservoir to conserve flood waters sufficient to irrigate approximately 22,000 acres of land. Work on this dam is to be commenced at once and to be completed within one year.

Articles of incorporation have been filed by the Del Valle Irrigation & Milling Company of Austin, Texas. Capital stock is \$20,000 and incorporators are Chas. G. Jones, J. G. Jones and J. C. Dumont, all of Austin.

Chas. B. Hunt of Wasta has secured permission to appropriate water from the Cheyenne river to irrigate 335 acres in Pennington county, South Dakota.

The Biggs Irrigation Company, which was recently incorporated under the laws of Delaware, has opened its principal office in Topeka, Kan. The officers of the company are S. V. Biggs of Moffatt, Colo., president; W. S. Roark, secretary, and Judge Lee Monroe, treasurer. The company has secured 6,000 acres of land between Pecos and Barstow, Texas, and will proceed to complete an irrigation system, the main canal of which extends already a distance of fifteen miles.

Surveys have been completed and work will be commenced in the very near future on the irrigation project on the Cannonball river near the town of Shields, N. D. The project comprises approximately nine acres and surrounds the townsite of Shields. The water supply is to be taken from Shields creek just west of Shields, where an earth dam 20 feet high and 400 feet long will be constructed.

Six thousand acres of land in the Colorado Indian Reservation, near Parker, Ariz., will be irrigated by a government pumping plant. Work on the plant, which will cost \$50,000, has already been commenced.

YOU WILL NEED THIS BOOK

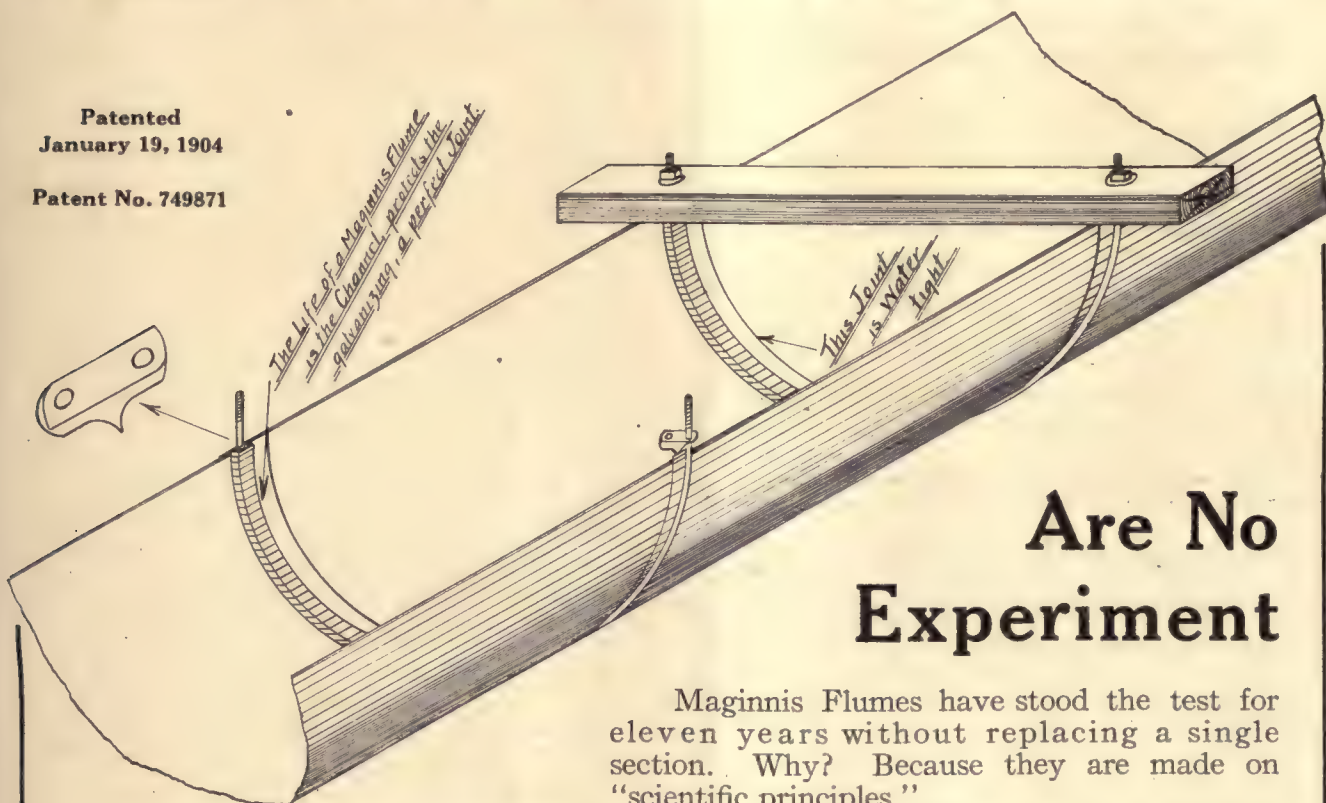
The Primer of Hydraulics will be ready January 1, 1912. Send \$2.50 for a copy of this newest and best book on Hydraulics for plain people.

Renew your subscription promptly; it helps restore confidence.

Maginnis Standard Galvanized Steel Irrigation Flumes

Patented
January 19, 1904

Patent No. 749871



Are No Experiment

Maginnis Flumes have stood the test for eleven years without replacing a single section. Why? Because they are made on "scientific principles."

The inner binder (which is part of the splice on the Maginnis flume) is made to check a silt in the bottom of the flume which protects the galvanizing. Without galvanizing a metal sheet will not last any longer than a stovepipe would if out in all kinds of weather:

The life of the Standard Maginnis Flume is the Channel Binder, because of the protection given the galvanizing, not only by checking the silt but by checking the sand (which is more or less common to all irrigation water), which if permitted to travel through a flume with the same velocity as water would cut the galvanizing off and leave a plain sheet of metal. - You know the results.

I am speaking from experience. To be exact, January 19, 1904, I received Patent Number 749871 for smooth inside flume. I, like a good many others, thought I had everything that was needed. At my own expense (not yours) I tried this flume out, more to determine the actual carrying capacity for measurements, etc., than anything else; to my sorrow I found that the sand would cut off the galvanizing when carried by the water through a smooth inside flume. I did not impose on my customers by putting this flume on the market, but continued to make the old reliable "MAGINNIS FLUME" which has now stood the tests for eleven years and given entire satisfaction.

A word about patents: I am the sole owner of the Maginnis Flumes patents, which were issued in 1902-1904 and cover inner and outer clamping members, inner binders, carriers rods, etc., in other words the only method of connecting two sheets of metal together and making them water-tight, without using rivets or solder. First used by P. Maginnis in experiments in 1901.

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Send \$1.00 for The Irrigation Age, one year, and the Primer of Irrigation, paper bound, a 260-page finely illustrated work for new beginners in irrigation.

MISSISSIPPI RIVER CHANGEABLE NEAR GULF.

A series of analyses of the water of the Mississippi River, made by chemists of the United States Geological Survey, reveals the changes in its character at different points. At Minneapolis the water of the Mississippi is very simple in character, being distinguished only by secondary alkalinity, primary salinity or permanent hardness. At Moline, Ill., permanent hardness appears definitely among the properties of the Mississippi water, although it occupies a very subordinate position. At Chester, Ill., however, the character of the water appears to be greatly changed, for the analyses indicate that the proportion of primary salinity is much increased and the proportion of permanent hardness is more than doubled. This change is due to the highly saline waters received from the Missouri at this point between Quincy and Chester. From Chester to New Orleans the river water appears to undergo no permanent change in general character. Additional contributions of saline waters from the West, received through Arkansas and Red rivers, suffice to maintain in the water of the lower Mississippi that high proportion of salinity first derived midway in its course from the Missouri River.

The investigation of the surface waters of the United States by the Geological Survey has accumulated a store of information concerning the amounts of inorganic material contained in the river waters of the country. A part of this information is contained in Bulletin 479, "The Geochemical Interpretation of Water Analyses," by Chase Palmer, just published by the Geological Survey. This bulletin may be obtained on application to the Director of the Survey at Washington, D. C.

Seventeen new homestead filings were made on the Huntley irrigation project, Montana, during the past month, leaving 103 farms available for settlers. Most of the remaining farms are 40-acre tracts, containing from 30 to 40 acres of irrigable land, and there is ample opportunity at this time to secure a first-class farm less than two miles from a railroad.

The Secretary of the Interior has suspended the con-

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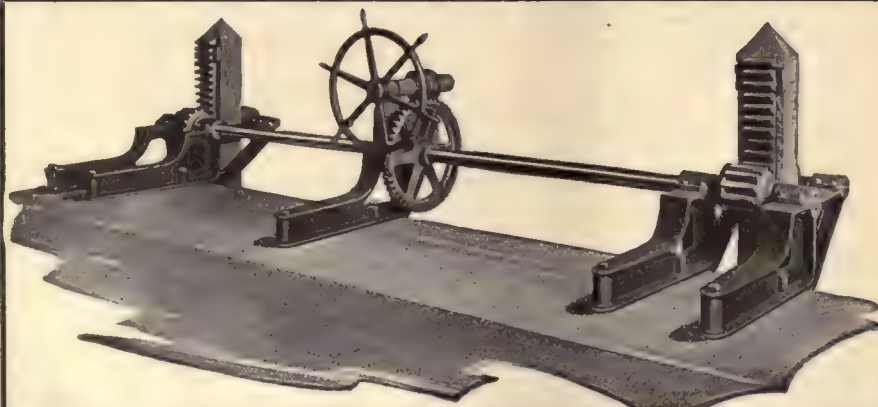
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The Palisade and Mesa
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Each Hoist operates a double stem
gate 12' wide 6' high.

Our line of Patterns enables us to
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THE DAYTON GLOBE IRON WORKS CO.
Dayton, Ohio

tract entered into January 2, 1911, with W. H. Mason, of Klamath Falls, Oregon, for the construction of the Lost River division channel, Klamath irrigation project, Oregon-California. This action was taken owing to the evident inability of the contractor to comply with the terms of his agreement, and for the further reason that it is highly essential that the work be completed prior to the beginning of the next irrigation season. The work will be completed by force account.

The Secretary of the Interior has authorized the Reclamation Service to construct three concrete drops and excavate about 80,000 cubic yards of material on Snipes Mountain Lateral, near Sunnyside, Washington, in connection with the Sunnyside unit of the Kakima irrigation project, Washington.

It is estimated that the entire expenditure involved will approximate about \$35,125.00.

The Secretary of the Interior has withdrawn from location, entry, sale, allotment, or other appropriations a large tract of land in the Blackfeet Indian Reservation, and has ratified all withdrawals and reservations for reclamation purposes heretofore made of lands within the said reservation. The withdrawal covers about 26,680 acres lying in Townships 29 to 37 N., ranges 7 to 14 West, Montana principal meridian.

The Secretary of the Interior is asking for proposals for the excavation and back filling of trenches, and the construction of wood stave pipe and other structures in the vicinity of Mabten, Washington, in connection with the Sunnyside unit of the Yakima irrigation project, Washington. The bids will be opened on October 16, at the office of the Reclamation Service at Sunnyside.

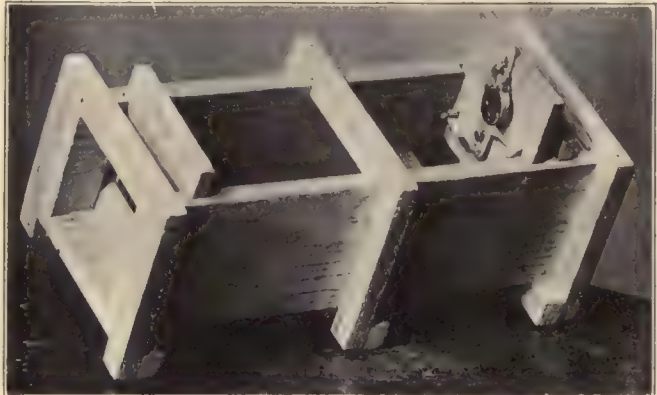
In connection with the work it is necessary to construct these crossings by force account.

The Secretary of the Interior has authorized the Reclamation Service to place cement linings in a number of the main distributaries, Umatilla irrigation project, Oregon. Plans for this work include the lining of more than 30,000 linear feet of canals and the construction of about 10,000 linear feet of cement pipe, at a total cost of approximately \$50,000.

Combination Headgate and Measuring Device.

The belief that Capital and Labor, that Employer and Employee, that Manufacturer and Consumer, that Home Office and Agent, that the House and the Salesman on the road should get together and stay together in a closer and more intelligent manner than ever before, and that all "Big Business" of the future should mean "Big Business" for all concerned, and not merely for the company itself, was the principle upon which this company was founded; and a summary of the results achieved in its short existence up to the present will show how well founded was that belief.

Loyalty to employer is a phrase familiar to all; but loyalty to the employee, while not so much in vogue, is just as essential to rapid progress along substantial lines.



On August 6th, 1911, the IRRIGATORS SUPPLY CO. was granted, by the great commonwealth of Montana, a charter with a capital stock of \$10,000. Loyalty to its agents and employees made it imperative to increase that capital stock to \$50,000, which was done on October 3d. And today, January 1st, 1912, we are arranging for a subsidiary company in the state of Washington, to take care of our business in that state. In two short months this same "loyalty to agents" has given us, in the state of Montana, four Agency Directors, as good traveling salesmen as ever slung a grip. They are A1, high-class gentlemen, prosperous and happy; and, through their untiring work and honest and intelligent manner of presenting our proposition, we now have thirty agents, selected from Montana's best business men, who, in turn, are preaching a uniform and equitable system of measuring water by the use of our COMBINATION HEADGATE AND MEASURING DEVICE.

At times we have felt inclined to the belief that the demand for the device itself was the cause of our rapid growth; but, with any other system or method than loyalty to the employee, we could not have covered the territory with such a sales force in so short a time, no matter what the demand or what the article we had to sell. So we are going to continue our plan with this as our slogan, "Loyalty to the Employee," and make each man a part of the great machine for selling our COMBINATION HEADGATE AND MEASURING DEVICE.

Although our device is approved by the best authorities of the state; although it has the endorsement of U. S. Senators and U. S. Surveyors, general judges and engineers; even though the judges of the courts recommend it, and some even require its use; and though it has the praise of our 800 Montana farmers who are using it, we find loyalty to the employee the most important factor in distribution yet discovered and recommend it to all employers, whether of one man or one million men.

If you are interested in, or troubled about, the measurement of water; or if this subject is causing trouble in your district, and you wish to be instrumental in abolishing the trouble, write, wire or 'phone the

U. S. Irrigators' Supply Co.

Montana Block, Missoula, Montana

Old Uncle Sam is still giving away land to his citizens

There are millions of acres of good government land in all parts of the West which are open to entry to any American citizen. **You, if an American Citizen, are entitled to 160 acres or 320 acres of government land.**

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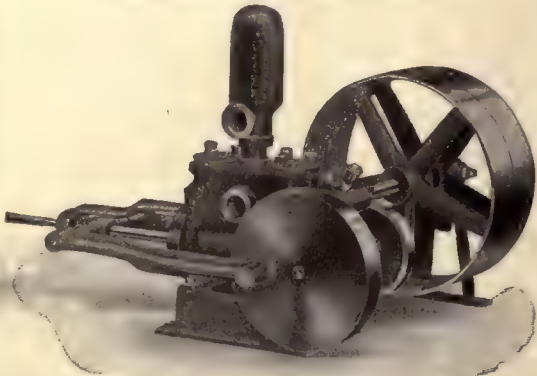
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IN THE PRESS NOW:

THE PRIMER OF HYDRAULICS

BY FREDERICK A. SMITH, C. E.

Hydraulic Engineer

This book is now receiving the finishing touches and will be ready for delivery by February 1, 1912. It is a volume of over 200 pages of absolutely new matter pertaining to the subject of Hydraulics and its allied branches. All the subjects treated are handled in a simple and practical way to make them of use to the men who have been unable to obtain a college education, but who are successful practical men in fields where they require a knowledge of the principles of Hydraulics and instructions how to solve their problems in a simple and satisfactory way. This book is indispensable for anyone engaged in works relating to Hydraulics, Irrigation or Drainage; it is primarily designed for the practical man in the field, but will be equally welcome to the trained Hydraulic Engineer especially, on account of the many valuable tables compiled by the author, which will save a tremendous amount of time in computations.

Condensed Table of Contents.

Article	I. General Properties of Matter.
Article	II. Algebraic Principles.
Article	III. Geometrical Principles.
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Article	V. Mensuration of Plane Figures.
Article	VI. Mensuration of Solids.
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Article	XIX. Ditches.
Article	XX. Ditch Tables and Their Applications.
Article	XXI. Flow Measurements.
Article	XXII. The Use of Logarithms.

Tables.

Fourteen tables giving the factor C for all cases of channels for a coefficient of roughness; n varying from .008 to .050, inclusive, for channels having a hydraulic radius from .01 ft. to 900.0 and for slopes varying .01 to .000025, thus practically covering every possible condition.

Tables of square roots of numbers used for r and s .
Table of Hydraulic Elements of the Circle.
Table of Hydraulic Elements of Composite Section.
Table of Areas and Circumferences of Circles.
Table of Hydraulic Equivalents.

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This is the name of an interesting little book. It tells about one of the finest, light reversible graders and ditchers ever made.

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Table of Weights of a Cubic Foot of Various Substances.
Conversion Table of United States and Metric Measures
and Weights.

Table of Squares, Cubes, Square Roots and Cube Roots.

Table of Logarithms.

Table of Natural Sines and Cosines.

Table of Natural Tangents and Cotangents.

Conversion Table, millions of gallons in 24 hours in other
units.

Table of sizes of pipes or cylindrical conduits required for
the flow of given quantities of water at given veloc-
ities.

Most all of these tables have been originated and
computed by the author and have been checked in prac-
tical work and found to be correct, so that the tables alone
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(Continued from page 104.)

people who are farming on business principles often get
a revenue from one crop of fruit far exceeding the total
cost of their property. A return of \$500 an acre from
apple orchards is not uncommon. Cases are cited of or-
chardists making as high as \$1,000 an acre on fruit.

Alfalfa, sugar beets and all kinds of vegetables are
produced in the Arkansas Valley, with grain farming on a
restricted scale. Alfalfa pays \$75 to \$100 an acre and
potatoes and other vegetables from \$100 up. I am not
interested in booming any locality, and I am satisfied from
what I saw of the irrigated system that equal profits may
be secured by our farmers right here in Illinois, as well
as by those in Iowa and the other grain states if they
will adopt irrigation and go in for the more modern, in-
tensive system of farming such as we see in Idaho and
elsewhere, where "organization and system" are first. The
Arkansas Valley in Colorado is in a surprisingly high state
of cultivation and prosperity, largely through irrigation.
I saw the great Teller dam, 30 miles from Pueblo, where
they store flood waters which serve to irrigate thousands
of acres. I also examined a number of irrigation sys-
tems, private and public, between that point and Boise,
Idaho. None of those sections could attract immigration
after the drought periods which have hit the north-
west were it not for pushing the irrigation plan on a sys-
tematic and gigantic scale so that all water that falls or
comes from melting snow is conserved and used when
needed most. Idaho is growing faster than any other

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The Chicago Irrigation Association
AND

The American Irrigation Federation

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motion and encouragement of the irrigation, re-
clamation, colonization and development of
land within the United States of America. It
maintains an office at 1110 First National Bank
Building, 38 South Dearborn Street, where there
is open to the public, free of charge, maps and
publications relating to the lands of the United
States. Questions relating to irrigation matters
will be answered by the officers of the Federation
and information given.

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northern state, owing to the enter-
prise and public spirit of the inhab-
itants. The 1911 assessment of that
state shows a valuation of 329 mil-
lions, against 127 millions for the as-
sessment of 1910. Naturally, there is
a good feeling among financial men
over this wonderful development. It
is a record breaker. There were hard
times there for several years, when
thousands were forced to leave the
state, but things are on such a good
footing now that nobody cares to
leave. My observation, however, leads
me to say the Carey act is not a good
law for the poor man. But if he can
capitalize his first five years and his
water supply holds out he wins.

At Pueblo I heard the most en-
couraging reports regarding general
business. The Colorado Fuel and
Iron Company is having the best year
for some time. Cripple Creek is
fairly booming again. All smelters
are in operation and the output of
metal is steadily growing. In Utah
also the copper, fuel and power
plants which I had a chance to inspect
are prospering nicely. Utah coal is
the best I ever saw and fast increas-
ing its usefulness.

There is one fact about irrigated
land that eastern people as a general
thing do not understand. It takes
comparatively little water to irrigate
for any crop, but especially fruit. In
some of the Idaho soil that would be
worthless without irrigation an inch
of water per annum is sufficient for
fruit. Orchardists put on only about
a quarter of an inch at a time, and
that is done three or four times a
year. With grain and vegetables per-
haps twice or three times as much is
required. The point is to have the
supply when there is a drouth and
when there is no other way to have a
crop. There may be an abundance of
water in the spring, perhaps too much,
but that does little good three months
later when the hot winds of summer
have baked the earth. A very small
amount suffices to keep the ground
porous and moist and to prevent the
fruit or other produce from parching.
In all the grain states there is an am-
ple supply of water every spring, and
some method of storing the surplus
would be valuable. Our central states
farmers could learn something from
irrigation and insure a crop with
small outlay for water, comparatively
speaking.

Where the storage is not all that
is desired, or is too expensive, it is
best to have artesian wells, which af-
ford a regular supply at a moderate
expense. In no case is it necessary
to spend more than \$25 an acre to
secure irrigation in a general farm-
ing country. Possibly a reader might
infer from what I have stated above
that there is no land in these irri-
gated countries selling for less than
\$150 per acre. That would be an er-
roneous impression, for good land can
be obtained in all of these newer
western states as low as \$10 per acre,
but this class of property is without
irrigation advantages and may be so
situated that it cannot for years get
railway facilities within a reasonable

LIGHT UP!

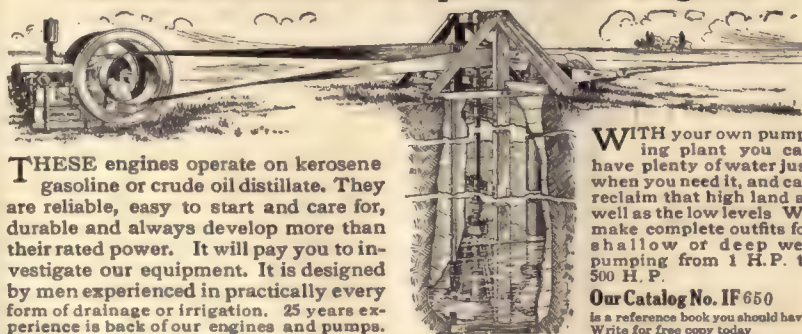
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distance. Its value is for grazing purposes or dry farming. The safe business proposition seems to lie in the well-located land where a reliable water supply has already been provided.

I also took occasion during this trip to view the results of dry farming methods. This, in brief, is a careful and thorough system of cultivation intended to get the best possible crops without an artificial water supply. By deep plowing and thorough harrowing the ground is fitted for the seed and then after planting it is rolled. For one thing this is better tillage than is usually given, and that counts a great deal. The deep plowing and the rolling tend to conserve the moisture about the roots of the crop. It is a correct principle and ought to be applied everywhere. Nevertheless, it will not work the wonders that we see in the irrigated districts, where soil that an eastern man would declare is pounds; in 1880, 3,500,000; in keep a sheep"—is producing magnificent crops. The dry farming plan ought to prevail wherever irrigation has not been introduced. It would add vastly to the sum total of our agricultural products.

It certainly seems to me that farming is growing more important every year, employing more people, attracting much money and many college bred men, and that it is the very best industry the United States has today or will ever have. The man who engages in farming as done by his father will generally fail, but to engage in the most stable business in this United States with care, intelligence and system, applying the business methods usually employed in other lines, I cannot see how one can fail, especially in the irrigated country.

Cotton importation has shown a steady if not rapid growth, especially during the last 20 years. Prior to the Civil War the quantity imported seldom reached more than 1,000,000 pounds per annum. During the war the quantity imported was quite large, ranging as high as 36,000,000 pounds in 1865, but dropping to 6,000,000 pounds in 1866, and less than 1,000,000 in 1867. By 1870 the total importation of cotton was 1,670,000 pounds; in 1880, 3,500,000; in 1890, \$8,500,000; in 1900, 67,000,000; in 1910, 86,000,000, and in 1911, 113,750,000 pounds.

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The failure of the farm to equal the factory on percentage of profit is not the fault of the farm itself—it is the fault of the operating methods employed. Cost of production must be closely watched—carefully tended—kept down. You cannot say what your product shall sell for—but you can keep the cost of production down. Every penny you cut off the producing

cost means the same to you as an increase of that amount in the selling price.



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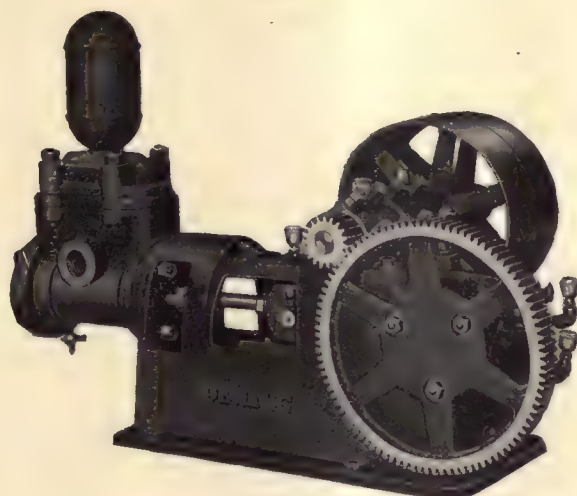
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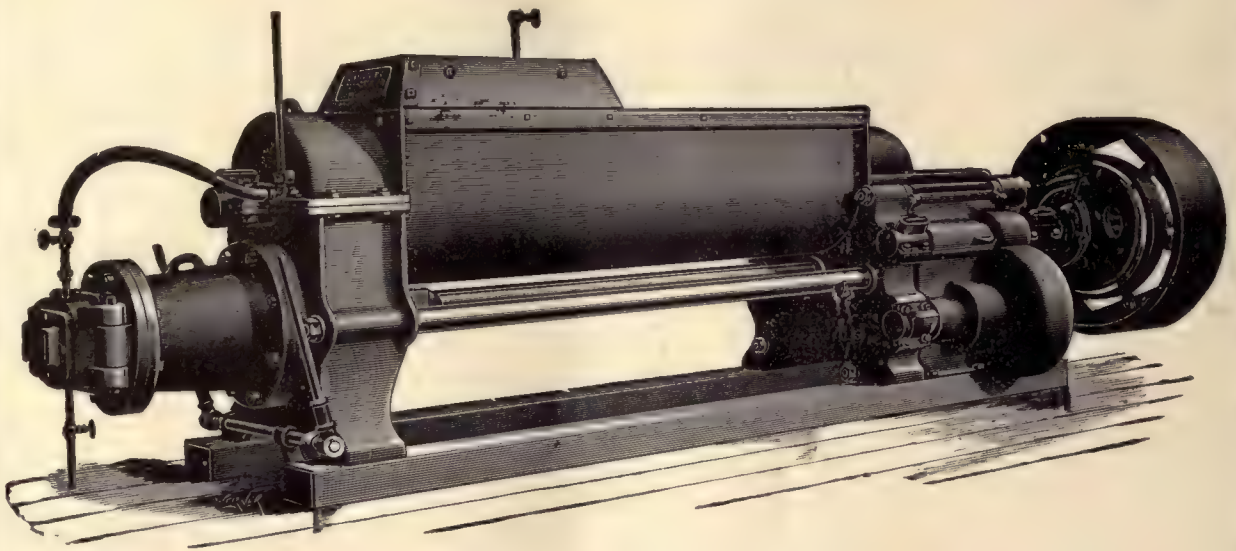
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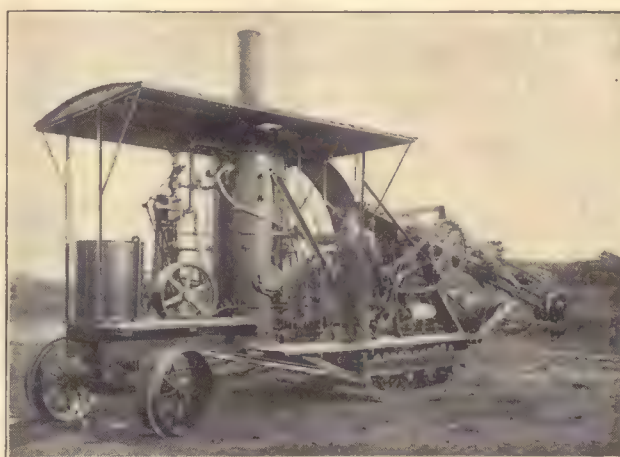
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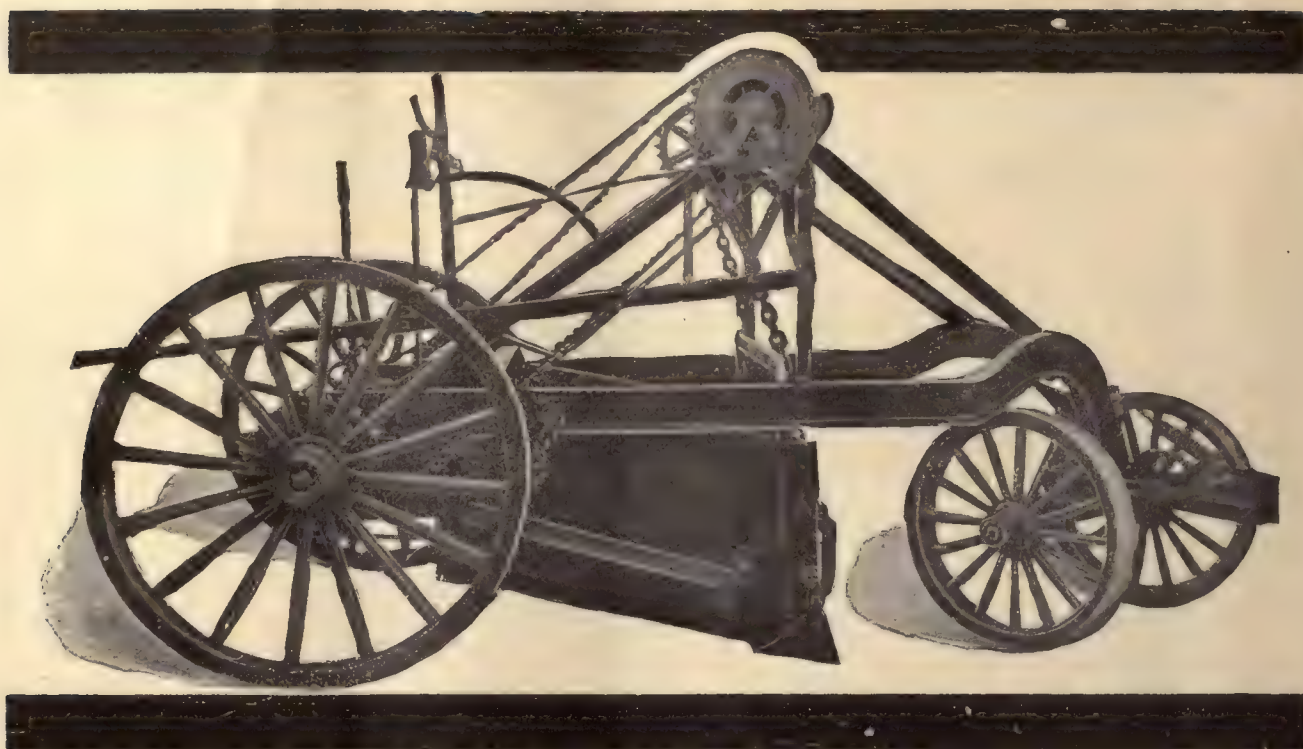
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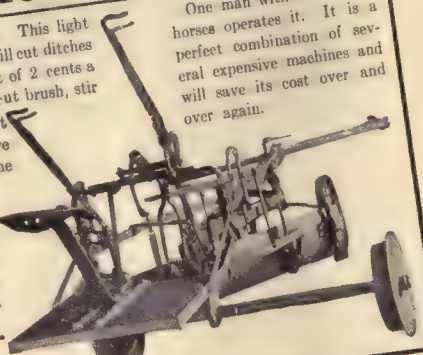
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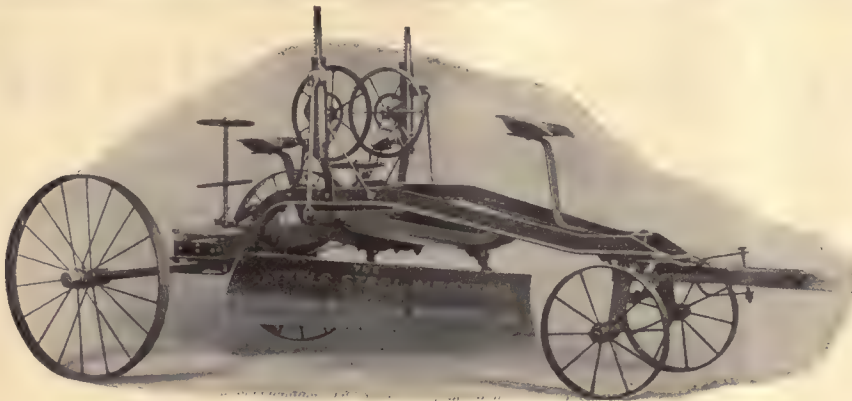
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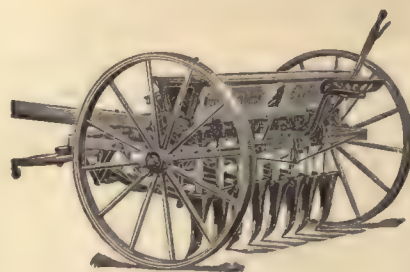
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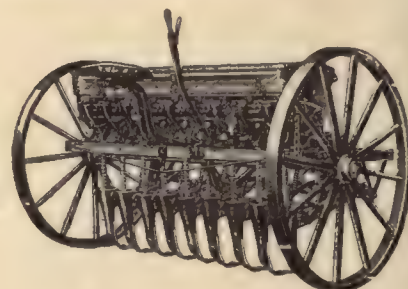
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Twenty-seventh Year

THE IRRIGATION AGE

VOL. XXVII

CHICAGO, FEBRUARY, 1912.

No. 4

THE IRRIGATION AGE

With which is Merged

MODERN IRRIGATION
THE IRRIGATION ERA
ARID AMERICA

THE DRAINAGE JOURNAL
MID-WEST
THE FARM HERALD

D. H. ANDERSON
PUBLISHER,

30 No. Dearborn Street, CHICAGO
Old No. 112 Dearborn St.

Entered as second-class matter October 3, 1897, at the
Postoffice at Chicago, Ill., under Act of March 3, 1879.

D. H. ANDERSON, Editor

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Irrigation Problems of the United States.

This issue contains a summary by Sam-
uel Fortier, Chief of Irrigation Investi-
gations of the Department of Agriculture
of the present status of the irrigation
development in the United States and
a forecast of the future.

There is no doubt that this is a very important and
interesting subject for our readers and we will briefly
comment upon it editorially.

The increase in population west of the Missouri is
one of the most encouraging factors, being 42 per cent
during the past ten years, while it was only 17 per cent
east of the Missouri during the same period.

The total amount of money invested in irrigation is
stated to be about 600 millions of dollars or about \$42
per acre, which is altogether a reasonable amount since
the value of the land prior to irrigation is mostly a small
item.

Mr. Fortier further states that of the 14,000,000 acres
under irrigation in this country over 6,000,000 have been
thus improved by individuals, either settlers or owners,
who have taken the pick and shovel and placed the irri-
gation ditches without outside help. This will no doubt
be news to many of our readers as the general idea
seems to be that irrigation is dependent upon big cor-
porations or the government in order to be successful.
Co-operative companies of farmers and settlers have
placed water on $4\frac{1}{2}$ millions of acres, while commercial
agencies have improved only $1\frac{1}{2}$ millions of acres and
the Reclamation Service of the government has placed
water on less than a half a million of acres.

Thus is proven the fact that individual efforts have done by far more for the advancement of irrigation than all other agencies taken together and this is really the better method as such farmers and settlers occupy the land, cultivate it, raise crops and gradually form happy and prosperous communities.

The "Forecast for the Future" contains many timely pointers which it will be well to consider carefully. According to statistics there are now something like 5 millions of acres supplied with water, ready for cultivation, but without settlers or tenants, and there are several more millions of acres being made ready for irrigation. These figures touch a vital spot and show that the principal problem at present is to provide settlers for the unoccupied irrigated areas rather than keep up construction work to increase the number of vacant acres. Some systematic efforts should be made to induce immigration to the irrigated lands and special advantages should be offered bona fide settlers in the way of cost of land and payments for water rights. More missionary work should be done among the city dwellers of people working in shops and factories and the point should be particularly emphasized that a competence on an irrigated farm in a healthful climate is within their reach by a judicious investment of their savings. Intending settlers should understand that success does not lie so much in the direction of a large acreage but rather on the quality of the work and that farms with a small acreage properly worked will produce larger returns than big units that are improperly worked.

**Your
Experience
Is
Valuable.**

Elsewhere in this issue appears a very interesting letter from J. L. Stinson, who describes how to raise corn successfully in the state of Idaho. It gives his experience with many disappointments and trials, but his efforts are finally crowned with success. The benefits of such work are far reaching and epoch-making, and the endeavors thus made and sacrifices brought by individuals reflect benefits and prosperity upon whole communities and states, even to whole nations.

The publicity given to letters of this kind is of vast importance in spreading such valuable information broadcast and making it available for farmers situated in similar circumstances to those surrounding Mr. Stinson. Hence the necessity of the progressive and successful farmer being a reader of the most up-to-date literature bearing upon the various phases of his work.

The columns of THE IRRIGATION AGE are peculiarly well adapted for disseminating knowledge of this character, as they reach many thousands of readers all over the world, all of whom are interested in the same objects; hence the experience of individual farmers when presented to them in a form as that of Mr. Stinson will surely prove beneficial to such readers and stir them to action. Some of them may have similar problems which may be solved directly by the methods described; others will have problems that cannot so be treated, but the success attained by the above named writer will fire them to experiment themselves like Mr. Stinson describes and many of them will be successful. But those who are unsuccessful must not feel discouraged but try to locate the trouble or cause of such failure. One of the greatest virtues of the farmer and irrigator is perseverance, which, if persisted in, will finally spell success.

As irrigators and farmers are mostly living in isolated

localities they have little opportunity to exchange experiences with each other, and the work of Mr. Stinson, referred to above, would probably never be known any farther than a few miles from his ranch. Here then comes the important function of THE IRRIGATION AGE, which periodical carries such information to many thousands of readers all over the earth giving every one the benefit of the experiences related. Thus the importance of the correspondence department in our journal must be conceded, and in order to increase its usefulness the editor again calls the attention of all readers to the necessity of writing to THE IRRIGATION AGE about their experiences in the way of raising crops, handling irrigation water, drainage, spraying and any other work which they deem interesting and instructive. No one is better qualified to write upon these subjects than the men who are actually engaged in the work from day to day. They encounter the difficulties and they discover schemes and methods to overcome them.

This experience which you gain by using your time and efforts is valuable to you, but more so to the thousands of readers of THE IRRIGATION AGE who may be facing the same problems and difficulties and whom you will save much trouble and loss by telling them of your methods and results. Hence don't neglect to inform the world of your successes; it will help yourself and your neighbor and advances the progress of the human race.

**Economy
Principal
Requirement
for Success.**

The time is at hand when producers and consumers of every kind must recognize the inherent law that economy in all its phases is an essential requirement for success. This applies with especial force to the farmer, and particularly to the irrigator. In his case the value of the land is augmented by the value of the water, which increases the cost of production, as there is an annual maintenance charge to be provided for in addition to a fair rate of interest on the original investment. Hence he cannot afford to waste anything that he produces. The time was when the farmers in the Central States would burn the straw after threshing their crops in order to get rid of it. Such folly of course does not exist at this time, as every stalk of straw is made use of everywhere at the present time. Perhaps there is no country in which economy in agriculture is higher developed than in Germany where the density of population is many times greater than here in the United States and where intense methods of farming must be practiced in order to provide for the wants of the nation.

A new departure has recently been reported from that country relating to the drying of potatoes for the purpose of reducing their bulk and weight. Ordinary potatoes contain about 90 per cent of water and by this new German process 75 per cent of this water is driven off so that 4 tons of potatoes, after treatment, weigh but one ton. The economy involved in the application of this principle in the United States where freight rates are high and distances great is at once easily seen and would have been no mean factor during the present year to reduce the high cost of living. With plenty of potatoes in the Rocky Mountain States the cost of a bushel of potatoes is doubled by the time it reaches Chicago, due to the long distance which it must be hauled by the railways, but with evaporated potatoes the cost of freight for one bushel would pay for the product of four bushels

and the concentrated product may be shipped any time without danger from freezing.

The machines which are in use in Germany for this purpose are of the drum type and the cost of treating one ton of potatoes (about 33 bushels) is \$1.30, including all expenses, which seems a very small amount when the advantages of the operation are considered.

Similar treatments might be applicable to other crops and their by-products, such as the drying of the sugar beet pulp, beet leaves and such like. The sugar beet factories in Germany preserve their pulp in this manner and by mixing with it a small quantity of molasses use it for an excellent stock food, some of which is exported to the United States.

There is no good reason why we cannot do these things here in the United States as well and with better financial results as they do in Germany and it is to be hoped that experiments will be conducted along these lines.

The New Ohio Spraying Law.

It will be of interest to our readers to learn that the legislature of the state of Ohio last year passed a compulsory spraying law, to take effect after the 31st of May next. The law states that every owner of an orchard consisting of ten or more fruit trees shall spray or cause to be sprayed such trees one or more times during the period from November 1 to April 13, with some suitable preparation for the destruction of the San Jose oyster shell or scurvy scale. A fine of from \$25 to \$100 for each year is provided for violation of this law.

This action of the Ohio legislature is a move in the right direction and we strongly recommend that legislatures elsewhere look into the needs of the fruit industry and pass similar acts as the needs of the respective states may require.

While we endorse the action taken in Ohio we cannot see why orchards of less than ten trees should be exempt from the law, and it might be more effective if the statute had been made to provide for the spraying of every tree in the state. An exempting provision like this may greatly interfere with the realization of the purpose for which the law was designed since the breeding of the San Jose scale may be carried on in a large number of small orchards which do not come under the provision of the law. If it is a good thing to spray trees in large orchards it is equally a desirable thing to spray small orchards and no exclusions should be made.

No law should be passed anywhere which is not binding upon all citizens alike unless some very good reasons are given for such exemption.

Prison Manufacturing Proves Unsatisfactory.

The annual statement of the Board of Control of the State Penitentiary of Michigan demonstrated the fact that the Binder Twine plant, operated by the prisoners in that institution, has been losing money during the past year, if proper charges were to be made for depreciation of plant and machinery, interest on the investment and for cost of light and power. This has been the experience of other state prisons to an extent where goods are manufactured in competition with free labor and proves that the principle is wrong and unsatisfactory.

There is no doubt about the necessity of keeping prisoners employed while they are serving sentences and

while they are a burden for the taxpayers of a state their services should be so directed in order to give such taxpayers the greatest possible benefit. This, however, is not accomplished by engaging in the manufacture of binder twine, or shoes, or any other commodity which interferes with the work and earning capacity of free labor in factories; the benefit of the prison-made goods does not affect the well being of the general public, but enriches usually some politician, and free labor is thrown out of employment.

The logical and best disposition of such labor is to use it for construction, maintenance and repairs of public highways and water courses. There is no state in this Union which has not work of this kind ahead for the next fifty years for all its state prisoners. This kind of employment is far more healthful and conducive to character improvement than shop or factory work. The outdoor work and exercise will bring about favorable reaction and keep the inmates in good bodily strength and good spirits.

It has been said, and truthfully so, that our public highways are a disgrace to the nation and yet how little is being done toward bettering the conditions affecting this means of vehicle transportation between the farms and towns, from village to village? There should be a good public road along every section line of the county, so the farmer can make a reasonably fast trip any time to his nearest town or market to dispose of his produce and to purchase goods for his own wants. The various states and counties are constantly pleading poverty and high cost of road building for the unsatisfactory conditions of their highways, yet the valuable labor of their penitentiaries might be put to work on them and produce wonderful changes for the better in a short time. In this way the taxpayers would get the best returns for the expenses of maintaining the state prison, and the farmer especially would be benefited a hundred-fold more than the small reduction in taxes ever would amount to in consequence of a possible net profit on prison-made goods.

After the public roads have reached a desirable condition of perfection then any available prison labor should be put to the improvement of water courses in the various states. There is a large amount of this work badly needed in each state and judicious work in this direction would save millions of dollars annually. This work should be done along the banks of all creeks or rivers where the adjacent land suffers periodically from floods; dikes should be built to keep the water within its course; channels should be deepened where necessary to increase the capacity, and, in short, all improvements tending to increase the productiveness of the land along such channels should be looked after by the state authorities and should be undertaken at the earliest possible moment.

The prison shop or factory should be abolished and prison labor should be used for the building and improving of public highways and water courses.

Irrigation Companies Must File Tariffs.

In a recent opinion of the state's attorney of the state of Washington it is held that power and irrigation companies in that state must file a tariff with the public service commission stating their charges for services rendered to the public. The issue was raised by the Hanford Irrigation Company of Hanford, Wash., which company does not offer for sale either power or irrigation service to the

public, but is engaged solely in providing water for its own lands for irrigation purposes, which lands it sells with a perpetual water right.

The opinion of the state's attorney is undoubtedly correct, for, although the Hanford Irrigation Company is not now engaged in the business of selling power and water, it may do so at some future time and if exempted now from the operation of the law might claim future immunity. Laws of this kind should be comprehensive and so framed that they cover a particular field fully and leave no loop holes whereby they may be made inoperative in certain cases.

Where there are laws in a state regulating public service corporations by all means let them be enforced without exception against all such corporations coming within the provision of them.

Thoughts

That

Come and

Go.

The two hot months of July and August of 1911 are being balanced nicely now by the two cold months of January and February of 1912. If the excess of the July and August heat could be mixed with the excessive cold of January and February the conditions would be far more appreciated.

* * *

It is a very misleading way in which the geographer usually determines the average temperature of a certain locality, namely, by adding the temperatures of all the days in a year together and dividing by the number of days. In this method the excessive high and low temperatures disappear.

* * *

Thus for the 4th of July, 1911, the highest temperature in Chicago was 104° F., and on the 4th of January, 1912, it was 18° F. below zero. The average temperature of these two extremes is 61° F., which looks very good as an average, but does not convey any idea of the suffering involved during the two days producing this average.

* * *

Note also how nearly these two extremes occur, just exactly six months apart; the writer has observed similar time laws on many occasions so that there might be discovered here a law of nature regulating these climatic and meteorological conditions.

* * *

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The Present Stage of Irrigation Development and a Forecast of the Future*

Twenty years ago I had the honor of being a delegate to the first National Irrigation Congress held in Salt Lake City. In celebrating the twentieth anniversary of this organization, it would be appropriate to pass in review the many achievements of the past twenty years in the development of the arid region by means of irrigation. The time necessary to make a presentation of this kind and the ability to perform the task are, in my case, both lacking, and I shall therefore be obliged to confine my remarks to a much shorter period and call your attention to but a few out of many achievements.

Government Irrigation.

Two branches of the United States Government have to do with irrigation. The Reclamation Service operates under the Department of the Interior in accordance with the provisions of the Reclamation Law of 1902. Under that law this service provides water supplies for government lands and has a fund at its disposal derived from the sale of the greater part of the public land in the West. This fund is employed in the building of canals and structures for certain well-defined tracts of land. It, therefore, expends large sums on comparatively small areas.

Our office, on the other hand, operates under the Department of Agriculture and receives annual appropriations from Congress for irrigation investigations. We cover a very wide territory with a very limited amount of money. Our organization not only extends over the whole arid and semi-arid belts where we carry on investigations helpful to the individual irrigators of those entire sections, but we are also making a study of rice irrigation in the Gulf States as well as of supplemental irrigation in the humid region.

The statements that I shall make in attempting to outline the present stage of development in irrigation are derived chiefly from our state agents and from the published reports of the Bureau of the Census, with which our branch has been cooperating for eighteen months past. They shall also be confined to the arid region, since Mr. Williams of our office is to follow me in presenting irrigation conditions in the humid region.

Importance of Irrigation to Western States.

Those of you who have watched the rise and progress of the commonwealths throughout the Rocky Mountain and Pacific Coast regions, must have observed how large a part irrigated products now bear to the total revenue. Unlike mining, which has unearthed countless millions by the toil of the many, but has allowed nearly all of this vast wealth to pass into the hands of the few, leaving the original toiler stranded and helpless, irrigation builds up enduring commonwealths, by establishing homes on the land and by fostering a high order of citizenship, good institutions and a stable government.

Irrigated agriculture lies at the foundation of much of the material prosperity of the West. Through the agency of water wisely used, deserts are converted into productive fields and orchards and herds and prosperous communities take the place of wild animals and an uncivilized race. It also furnishes food and clothing for the dwellers in cities, raw material for the manufacturer and traffic for the transportation company. If it were possible to remove from the arid region the comparatively small area which has been rendered highly productive by means of irrigation, it would go far to undo the labor of half a century in building up the western half of the Union.

The Population of the West.

The census for 1910 gives the population of the 17 states and territories lying west of the Missouri river at nearly 16½ million. This is an increase of 42 per cent in 10 years. In the same time the rate of increase throughout the remaining 31 states was only 17 per cent. I often look upon the trend of population from east to west in this country as bearing some resemblance to the passage

*By Samuel Fortier, Chief of Irrigation Investigations, Office of Experiment Stations, U. S. Department of Agriculture.

of raw material through a mill. The raw material is dumped into the hoppers of the immigrant-seeking states of New York and Pennsylvania and the finished product emerges on the Pacific Coast and the slopes of the Rockies. This is indeed fortunate for the West, for if there is any place where the quality of the man counts it is on an irrigated tract.

So rapid an increase in western population should not be attributed solely to the irrigation of desert lands. Of late the dry farming districts have attracted thousands of settlers, more manufactories have been established, more railway lines built and ever-increasing numbers are seeking homes in towns and cities.

Money Invested in Irrigation Works.

The progress of irrigation development may also be measured by the amount of money invested in irrigation works. The census figures for 1910 place this amount at nearly \$305,000,000. Dividing this sum by the total acreage irrigated, gives \$22 as the average price per acre of irrigation works, such as reservoirs and main canals. This, however, does not include the expenses incurred by the farmer in installing head ditches and laterals and preparing his land for irrigation. These expenditures would easily average another \$20 per acre, raising the total to something over \$40 per acre and giving us a grand total of approximately \$600,000,000 of capital invested.

Large as this sum may appear, it is yet small when compared with the wealth created by the water which such works have provided. If one reckons the cost of irrigation works in millions, he should use billions as a unit to reckon the values created by the water which they furnish. A relatively small amount of capital is invested in the pumping plants and canals of the Santa Ana Valley in California, but the purchase of the citrus orchards and other improvements which this pumped water has created would entail an immense outlay. The irrigated lands of few localities possess such high values, but the comparison is true for all irrigated districts.

Agencies in Irrigation Development.

It is of interest to note through what agencies this vast wealth has been created. What has the individual irrigator done and what forms of organized effort have been instrumental in helping him to accomplish so great an undertaking?

Several distinct forces have contributed to this result. In the first place we have the individual irrigator who has either built a ditch himself or called in one or two neighbors to help him. Out of a total of nearly 14,000,000 acres of irrigated land in this country, we must credit this class with 45½ per cent (over six million acres). Next comes cooperative companies without formal organization, which are really merely larger groups of farmers acting together to build the necessary structures. This class covers another 33.8 per cent (over 4½ million acres). Then comes the commercial enterprises of one sort or another which have launched into the business of furnishing a water supply and selling it to the irrigator. This class covers 10½ per cent (roughly 1½ million acres).

Irrigation districts, a sort of quasi-municipal corporation, come next with 3.9 per cent (approximately one-half million acres).

The Reclamation Service is next in line with 2.9 per cent (less than 400,000 acres).

Companies operating under the Carey Act come next with 2.1 per cent (something under 300,000 acres). Under this act the National Government grants to each of the arid states not exceeding a million acres of desert land, with the proviso that the state shall obligate itself to reclaim the same and cause it to be occupied by actual settlers in small tracts. The states which accept the act in turn enter into contracts with corporations which construct the works and sell water rights to the settler.

Lastly comes the United States Indian Service with 1.3 per cent.

The figures given in detail are as follows:

	Acres.	Per Cent.
Individual and partnership enterprises.	6,258,401	45.5
Cooperative enterprises.....	4,646,039	33.8
Commercial enterprises.....	1,444,806	10.6
Irrigation districts.....	533,142	3.9

U. S. Reclamation Service.....	395,646	2.9
Carey Act enterprises.....	288,553	2.1
U. S. Indian Service.....	172,912	1.2
	13,739,679	100.0

Lands Irrigated and Farms Established.

I have but time to touch briefly upon the geographic distribution of irrigation and the sections where it is making greatest headway. California and her great rival of the Rocky Mountain region, Colorado, are still well in the lead as regards irrigation, but the progress of neither during the past decade has been so rapid as that of Texas, Washington, Idaho and New Mexico. The Lone Star State is in a class by herself in this respect. Excluding the area given to rice culture, Texas has gained 300 per cent in irrigated area in the decade mentioned. Washington, Idaho, North Dakota and New Mexico have each more than doubled in the same time. Oklahoma stands at 96, Wyoming 86, Montana and Oregon 77. Colorado's increase was 73 per cent and California 66 per cent.

As water is provided for dry land, more farms are carved out of the desert, the increase in the number of farms keeping pace with the construction of new works on the one hand and with the establishment of homes on the other. It is surprising that more than one-fourth of all of the irrigated farms that have been established in the 17 western states and territories between 1899 and 1909 has been in California. Rapid progress has also been made by Texas, Washington, Idaho, Wyoming, Colorado, New Mexico and Oregon in the order named. While the states of Oklahoma, Kansas, Nebraska and the Dakotas have greatly increased their areas under irrigation, the number of their irrigated farms has not increased in this past decade.

Improvement in Irrigation Practice.

The past decade has also witnessed a marked improvement in irrigation practice. Lumber, which was once so generally used, is rapidly being replaced by concrete and steel, resulting in better, safer and more permanent structures. Greater efforts are put forth to prevent unnecessary waste in transmission of water by lining canals. The surfaces of fields are being better prepared to receive water and more care and skill are being exercised in laying out farm systems.

Among the irrigators of Western America are to be found nearly all classes and nationalities. Each settler from another state or from a foreign country introduces on his farm some custom or practice common to his old environment. In this way we gather from every corner of the globe ideas about irrigation. These are being tested out under favorable climatic and soil conditions by an intelligent people working under free institutions. The result is a foundation so deep and broad that foreign scientists and engineers are visiting America in ever-increasing numbers to learn about this new practice in American irrigation.

A Forecast of the Future.

I have touched upon a few of the achievements of the past, but what of the future? The west is now undergoing a temporary set-back, but a slacking of the too rapid pace of recent years may prove beneficial in the end. The rate of progress as I shall attempt to show, has not been uniform in all directions and it may be well to halt the vanguard until the stragglers in the rear catch up with the procession. It is a fact that the building of irrigation works is far in the front and the settlement of irrigable lands is far in the rear. There are today, 5 or 6 million acres supplied with water, but unirrigated for lack of settlers. In addition to these areas that await settlement, there are fully ten million acres included in partially completed projects, the managers of which are anxiously looking forward to the time when the water will be in the canals and the settlers on the land. We naturally compare this total acreage, which is to be opened to settlement in the next seven or eight years, to the rate of settlement of the past decade. In ten years of good times we have added to the irrigated area of the west but 6,200,000 acres. In other words, in order to bring settlers to the fifteen million acres of lands which are ready or will be ready to be served by irrigation canals in the next seven

or eight years, we will have to procure settlers about three times as fast as we have secured them in the past decade.

Now, no transportation company would be foolish enough to construct a railroad and make no provision for its operation and maintenance. Is it therefore wise for irrigation enterprises to provide water supplies for lands which can not soon be cultivated and irrigated? Four years ago when this Congress met in Sacramento, California, and still again at its sessions in Spokane, Washington, and Pueblo, Colorado, I tried to point out the large areas of land that were unreclaimed because there was no one to plant the seed and moisten the soil. I then urged as I do now, that more consideration be given to those features of irrigation which directly concern the irrigator. It is now our duty to teach the man already on the land how to get higher returns from the areas already open to settlement. Throwing open new areas will not solve the problem. We must demonstrate increased returns from more intensive cultivation, better methods of applying water, more wisdom in planting and in harvesting.

The west must not place on the industrious settler a burden greater than he can bear. Already the price of land under many of the irrigation enterprises is more than he can pay for. Raise it a little higher and he will stay at home.

The value placed upon the farm lands of the United States by their owners has increased 117 per cent in ten years, but the value of lands in eleven of the far western states has increased in the same time 203 per cent. Only a little more inflation is needed in some irrigation districts to burst the bubble created by land boomers. Then the rallying cry will be "Back to the shop and the city."

The rapid increase in the value of irrigated land applies with equal force to the value of water. Enterprises which charged \$20 an acre for a water right a dozen years ago have been followed by others which charge double and treble this amount. There is, however, this difference between the two. The value of water is not fictitious. Its upward trend in price has been due to the fact that the supply available for future use is becoming every year less and less. We shall probably never see the day when water will sell for less than it has in 1911. In the states where irrigation is practiced, there are in improved farms 173,000,000 acres, but of these, less than 14,000,000 acres are irrigated. The time will perhaps never come when more than 50 million acres are irrigated and the large balance which is doomed to be farmed dry will be certain to keep the price of water at a premium. Now, as regards the high price and scarcity of water for irrigation purposes, two courses are open. One of these is to continue to reach out for fresh supplies as we have done in the past and attempt to utilize these at great cost to the irrigator. The other course is to use with greater economy the water already appropriated. It is not incumbent upon western people to utilize all the water resources of the arid region before 1920 or even 1930. The irrigation structures we are now building and the methods we are pursuing may be thought inferior by our boys when they reach maturity. Then why not leave a little water in western streams for our boys to utilize? It should be our chief concern to make better use of the water we have taken from its natural channel.

Present conditions in many of the irrigation states call for, we believe, a readjustment of land values. While this readjustment is being made, every effort should be put forth to increase the yield and value of irrigated products. Occasionally enormous yields and corresponding profits are obtained from irrigated land. These are freely used as a warrant for holding irrigated lands at a high figure. Nevertheless, it is a fact that the average returns per acre even in the irrigated districts are only medium. Not many parts of the west are more favorable to the growth of alfalfa than Southern Idaho. At our demonstration farms a seasonal yield of 8 to 10 tons per acre of either red clover or alfalfa is readily obtained. It is therefore somewhat disconcerting to learn that the average seasonal yield of irrigated alfalfa for Southern Idaho in 1910 as obtained by the census was only 3.26 tons per acre. What is true of Idaho is also true with few exceptions of the entire west. The farmers are not getting anything like the greatest possible returns from their irrigated farms.

The census figures show that up to a year ago the extent of land irrigated under the U. S. Reclamation projects was less than 3 per cent of the total. In other words, more than 97 per cent is controlled by individuals, associations, communities and corporations acting under the irrigation laws of western states. These laws and the customs on which they are founded, are still, for the most part, in a formative stage. At every session of state legislatures, some new ideas are crystallized into law, and statutory enactments which were thought almost perfect fifteen or twenty years ago, are modified to meet the requirements of changing conditions.

In many states of the west, progress in irrigation is being retarded and costly investments rendered insecure by the lack of proper legislation on the part of state legislatures. Some of these urgently needed laws are clearer definitions in regard to the flow of water in streams and its use in irrigation. Colorado, at the close of 40 years of wonderful achievements in the reclamation of her arid lands, is going back once more to the irrigation primer in an effort to find out the meaning of direct irrigation. It may cost the farmers of this state a million or more dollars to find out whether winter irrigation should be defined as direct irrigation or merely the storage of water in the soil.

Again, if priorities are to hold on the waters of streams lying wholly within the state lines, they should also hold on inter-state streams. A law so general as that of priorities should not become inoperative by crossing an imaginary line which separates two political divisions.

Western states, through their respective legislatures must also get behind the irrigation bond. If it is not feasible to guarantee the irrigation district and Carey Land Act project bond it should be safeguarded by state officers in every possible way. Failing this, such bonds are likely to be discredited and thereby tarnish the good name of western states.

The needs of better and wiser irrigation laws is not more urgent than that of better and more efficient administrative systems. The state irrigation engineer, if not the nominal head, is usually the active head of such systems. When this office is kept out of politics and the incumbent given a long term and a fair salary, good work may be expected, providing the law under which he is operating is satisfactory. On the contrary, when the administrative law is defective, the term of office two years, the salary low and the incumbent more of a politician than an engineer, the great irrigation interests of the state are likely to suffer.

I am unwilling to conclude this brief paper without first reiterating my abiding faith in irrigated agriculture and the final triumph of the west over all obstacles. I can see no good reason to believe that progress in the decade which lies before will be less rapid than in the decade which is past. I have merely called attention to a few things which may retard development unless adequate measures are adopted to safeguard all interests. In my humble opinion, some of the most important of these are, the speedy settlement of lands now under ditch, the giving of additional aid to settlers on irrigated farms, a readjustment of land values and more particularly, orchard land values, a more economical use of appropriated water supplies, broader and better irrigation laws by western states and more efficient administrative systems.

A GREAT ENGINEERING WORK.

The first step in preliminary construction preparatory to building the highest dam in the world has been accomplished in the completion of the mammoth diversion tunnel at Arrowrock dam, Boise irrigation project, Idaho. This tunnel when lined with cement will be 25 feet high and 30 feet wide, larger than a double track railroad tunnel, and will carry the whole flow of the Boise river during the construction of Arrowrock dam. The tunnel is 470 feet long, and driven through solid granite for its entire length. Its excavation was completed several days ahead of schedule time.

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ON THE ROOF OF THE WORLD*

Modern Cuzco is an example of the passing of the old and the growth of things that are new. Only in 1909 the railroad reached this city, and now there are street cars, and soon this ancient capital of the sun worshipers will be lighted by electricity. In the old days, before the Spanish conquerors came, the Incas had an immense park in the center of the city, but the viceroy of Spain had this park cut into three plazas and houses built around them. While more compact than



Plaza and Cathedral, Cuzco, Peru.

in ancient times, the city is very picturesque and unusual in appearance. The private residences, offices, agencies and banks all open onto beautiful patios, or courtyards, which are full of blooming flowers and often contain fountains of splashing water. Only shops, or stores as we call them, open onto the streets. You see how different things are in Cuzco from towns in the United States.

Everywhere in this region one sees Indians, in the streets and on the country roads, doing all sorts of common labor. They work very cheap, receiving usually about thirty cents a day. They are the descendants of the Incas, and look a great deal like our North American Indians. There is a big market place in Cuzco called the Plaza San Sebastian. One sees lots of Indians there, especially Indian women, who sit under little canvas tents with their wares in front of them, arranged in small piles. They bring their goods to market on the backs of llamas or burros. That is a feature of life in the Andean country that always interests the traveler, the trains of long-necked llamas and little burros carrying goods through the streets of the towns and along the roads that wind among the mountains. One sees lots of them in and about La-Paz, the capital of Bolivia, for it is the highest capital city in the world, and people almost never use horses. In fact, in La Paz the altitude is so great, 12,500 feet above sea-level, and the streets often so very steep, sometimes only human beings are practicable in delivering goods. The Indians, therefore, do much of the freight-carrying in the town. Cuzco is 10,500 feet above the sea, and even there the white people walk about only as it is necessary, though, of course in time they become accustomed, in a degree, to the high altitude.

The prefect of Cuzco invited me to review the military force stationed in the city, and though there were but 550 soldiers, they made a fine appearance in their bright uniforms, with their splendid band discoursing music as they marched by. They had an odd battery of artillery—rapid-fire Maxim guns mounted on mules. In times of war these mule batteries are very efficient, as they can

cross the rough country and climb about the mountains rapidly.

On Sunday in Cuzco the air is thrilled at times by sound from the great bell in the steeple of the massive cathedral on the Plaza Des Armes. This huge, deep-toned bell is called the Maria Angela, and is famous throughout Peru, its composition being largely of gold. There are many churches and convents in Cuzco, built by the Spaniards after their conquest of the Incas, some of them being erected on the foundations of the Inca temples, while several of the old convents are used as stores by the modern merchants. The church of La Merced is built on the foundation of an Inca temple once dedicated to the worship of the sun, and the convent of Santo Domingo is built on the foundation of one of the richest of the Inca temples, a Christian altar, it is said, occupying the very place where the Incas' sacred emblems to the sun god were guarded by their high priests. They also told me

that the cells for the nuns in the convent of Santa Catalina are the ones occupied long ago by the virgins of the sun. It is all very strange, isn't it?

Ancient Cuzco was the treasure city of the Incas. The tribes, in paying tribute, brought great stores of gold and silver and precious stones into the temples. It held at that time probably the greatest store of treasure of any city in the world. When the Spaniards conquered the Incas they carried away over \$100,000,000 of gold alone, besides the other priceless treasures of the Inca temples of Cuzco. It makes one fairly gasp to think of such a stupendous robbery.

The prefect of Cuzco arranged that I should have a horse belonging to the cavalry, and accompanied by a guard of soldiers, with Indians carrying my cameras, I climbed the mountain where, high above the city, are the ruins of the Inca fortress of Sacsahuaman. The ascent is so steep in places that steps have been cut in the rocks to insure a safe footing. On the way to the summit we passed the ancient palace of the monarch Pachacutec, and a little beyond the High Priests' Temple of the Sun. There is no explanation of how the massive stones were brought to construct these buildings, but it would be interesting to know, for one stone I measured on the fortress was thirty-two feet long, twelve feet wide, and very thick. Its weight must have been enormous. Near



Indian Merchants in Plaza Arcades, Cuzco.

*By W. D. Royce, Chicago.



Mr. Boyce on His Way to Inca Ruins.

the fortress is a level plot on which Cuzco's modern society dances every clear Sunday afternoon. Near by is a great natural rock slide, work away in spots to a depth of six inches. Here the Incas used to have sliding races, the one who was daring enough to first reach the bottom receiving a pot of gold.

The ruins of Ollantaytambo, north of Cuzco, are most interesting. Here the Inca monarchs had their summer residence. The ruins are on a height at the edge of a precipice a thousand feet deep, commanding a gorge through which the Urubamba River runs to the Convection valley in the wild regions of the Amazon. They show one an odd grotto cut in the rock near the top of the great winding stone stairway that leads to the ruins. This grotto is known as the seat of the Inca's daughter. In its center is an altar six feet square, cut out of solid stone, where, it is said, the Inca high priests performed religious rites, accompanied by human sacrifice, before the emperor and his court and the people assembled on the plains below.

There are numerous other extremely interesting things to see in and about old Cuzco, and all through these mountain-lifted highlands. But far south of Cuzco, on the dividing line between Peru and Bolivia, one comes by rail to Lake Titicaca, which sets one to marveling. It is the highest body of water in the world navigable by steam, being 12,500 feet above sea-level. It is the largest lake in South America, its length being 155 miles, with an average width of 44 miles. You see, it is quite a little ocean right up among the mountain tops. I crossed it to Bolivia on a steamer that was brought in parts from Europe by sea, and from the coast was brought up to the great plateau by rail, then put together on the shore of the lake. The waters of

Lake Titicaca are always icy cold and, curiously enough, no metal, even iron or steel, will rust in it. There are very remarkable ruins of prehistoric times in this region, those at Tiahuanaca being called the "remains of the oldest city in the world."

After an inspection of these ruins I was whirled away in a special car toward La Paz. I first saw the Bolivian capital, in the dusk of the evening, from Alto LaPaz. At that point I was above old LaPaz, and, illuminated by thousands of electric lights, it glowed and sparkled in the valley below like a picture in Fairyland. The capital is surrounded by enormous snow-capped mountains, one of which is 22,500 feet above sea-level. It is cold in LaPaz much of the time, and Americans, especially, find it hard to keep warm. But the city is most picturesque, the walls and roofs of the houses being painted in variegated colors, ranging from solid red or blue to the most delicate shades of pink and lavender. An odd thing is that the street cars in LaPaz stop running at 7 o'clock in the evening, and there are no theaters. The reason for the latter fact is that singers and actors coming into this high altitude cannot "catch their breaths" long enough to sing or speak their lines properly. On climbing from one street to another one often has to stop and "breathe hard" before proceeding. In these high altitudes strangers are sometimes attacked by a sickness called "soroche," a dizziness and nausea that is extremely disagreeable. In time, however, one becomes accustomed to these high regions.

The pure-blooded Bolivians of Spanish descent constitute the aristocracy of the country, and the women have pretty faces and big brown eyes. They dress much like the women of the United States, except when going to church, when they wear black clothes and half hide their faces with "mantos" draped about the head. The Indian men wear trousers split at the back up to the knee to give them greater freedom in walking up hill, and ponchos—brightly colored shawls through the middle of which the head is stuck—constitute their chief adornment. The Indian women wear a scanty skirt and shawl, and often, peeping out from a second shawl tied over the shoulders, one sees the ruddy face of an Indian baby. The babies are strong and seldom cry. I found the photographing of the Indians often difficult; sometimes they took to their heels, believing the camera to be some sort of amazing "gun" which was being pointed at them.



Scene on the Road to Inca Ruins.



Indian Stone Carriers Near Cuzco.

It was with regret I left this unique country behind, for there are many strange and unusual things throughout all the Andean regions of which I would be glad to tell you had I the space. I was much impressed by the great extent of South America and its enormous natural resources. It is a wonderful country with a splendid future. I hope that some, at least, who will read this may sometime travel in South America and see for themselves how interesting it is. While I was traveling through that country I wrote many descriptive articles for publication in *The Chicago Saturday Blade*, and presently I expect to publish a book that will tell more fully about the many remarkable things I saw in the great continent that lies to the south of us.

Albert S. Byers, formerly commissioner of Franklin county, Washington, is beginning preparation for the reclamation of 50,000 acres of land along the Columbia river north of Pasco. It is said that work will begin sometime in March or April. This development was made as a result of concessions from the Northern Pacific Railway Company, which owns 17,000 acres in, or adjoining, this project.



Fountain in Cuzco.

The Alberta Railway & Irrigation Company, at a meeting held recently in London, agreed to plan to either lease or sell to the Canadian Pacific Railway Company all of the company's undertakings in return for a guaranteed annuity of 6 per cent on its capital stock.

The Secretary of the Interior has granted authority to the Reclamation Service to purchase nine 300 K. W. 26,000 volt twenty-five cycle transformers from the Wagner Electric Manufacturing Company of St. Louis for \$16,065. This purchase is supplemental to a contract for similar machinery bought for use in connection with the power plant on the Salt River irrigation project, Arizona.

The Secretary of the Interior has withdrawn from all forms of entry 3,840 acres of land in Township 47 N., Range 8 E., Mt. Diablo principal meridian, for pasture purposes for stock used in connection with the construction and operation of the Klamath project, Oregon-California.

The Ambursen Hydraulic Construction Company of Canada, Ltd., has been employed to build a new dam for the Deschambault Electric Light Company, P. Q. The dam is 65 feet high and is in a box cañon 45 feet wide at the bottom and 100 feet wide at the top. The type of dam is a reinforced concrete arch of light cross section.

A. W. Gardner, of Houston, Tex., said to be representing Cleveland capitalists, is reported to be concluding negotiations for the purchase of a controlling interest in the Brownsville Irrigation Company at Brownsville. This company is capitalized at \$100,000 and owns a pumping irrigation plant capable of watering 15,000 acres thirty-five miles of canals, and 2,500 acres of land near Brownsville.

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Street in Cuzco Showing Old Inca Foundation.

GOOD ROADS*

While Wisconsin has nothing to boast of in the way of good roads, I am still happy to plead guilty when introduced as one of its citizens who has unbounded faith in our future. All that is needed to place us in the fore front is the right sort of enlightenment on this good roads movement.

This good roads movement is all right; it will endure unless we find ourselves in the position of the Irishman who had been riding with his friend on the ice wagon. Pat had fallen off and two wheels had passed over his neck; Mike, the driver, leaned out and shouted: "Are ye killed, Pat?" "Divil a bit," says Pat, "O'im all r ight if ye don't back up." So are we all right if we won't back up.

This good roads' movement started way back in the days of the Roman Empire, years before Christ. These same Romans knew how to make good laws; laws that today are the foundation of many of our present statutes, they have endured the test of time. So too, did the Romans legislate in favor of public highways, work on which was done by convicts and the soldiery. They made a study of road building, and the proper maintenance of



T. W. Gilson, Assistant Secretary.

same. Those public highways have stood through all the ages as a living monument to a people whose influence has rarely been equalled. What was the result? Nowhere in the world do we find such universally magnificent highways as in Europe and this good roads movement, started, two thousand years ago by the Romans, has been the all-powerful influence directly responsible. Generation after generation have carried on this wonderful work; it is a proud inheritance passed on from country to country, city to city, town to town, hamlet to hamlet, father to son; the poor as well as the rich have enjoyed the benefits.

Extraordinary natural resources or monetary advantages had nothing to do with this condition; it was the scientific study of this problem that resulted in a practical economical solution of good road building, together with a keen realization of the advantages accruing to all classes that places European countries in the enviable position of leading the world in the good roads movement.

How long shall this great country of ours remain in a state of coma on this question of national improvement of our public highways? Shall we longer submit ourselves

to the humiliation of bringing up the tail end of this good roads procession? Why should this glorious country with all its scenic beauty unequalled in the world be handicapped for lack of highways that would make it possible for our own people as well as those of other countries to comfortably enjoy them? All this God-given beauty of scenery should be made accessible for the modern means of travel; believe me there is no other one agency that will do more toward the development of this country of ours; for bringing the people in closer touch, to say nothing of the tremendous saving to those who must use the highways for business purposes such as the hauling of freight or the marketing of farm products.

It is for us to awaken the sluggards, to arouse public enthusiasm to the point where they will become fanatic on the subject of good roads. If politics are being injected into this proposition to the detriment of our cause, let us stamp it out with that never failing weapon education; let us make the people, one and all, rich or poor, reason it out for themselves, uninfluenced by unscrupulous politicians whose only aim is to serve the people incidentally and themselves principally. I believe politics should have no place in this grand movement for good roads; it should be fought out along non-partisan lines to the last ditch with this as our slogan, "Built by the people for the people."

Let us have a national highway from coast to coast built by federal aid, states, counties and townships contributing if you please, but no matter how it is built let us have it.

Right at this point I want to ask why should not the convicts in our federal and state penal institutions do this work of building public highways? As a matter of economic disposition of this convict labor for this purpose there can be no question. Statistics, with which I shall not burden you place this question beyond the pale of argument. It has been proven a money making proposition in a number of states. I have seen the result of this work and it is a credit to any state; those people who have exercised their right of franchise to force the use of convict labor for road building have done more than they realize for the benefit of this country.

I ask you how could the people of a state get better results for the money they expend in taxes for the support of convicts than by insisting that their highways be built and maintained by convict labor? The people pay the tax and they should reap the benefit.

To return to the question of a national highway; if the federal government would set the glorious example, acting under the Constitution which provides a government of the people, by the people, for the people, a wave of good road enthusiasm would be set in motion that nothing could stop and the goal would be in sight.

To accomplish all this means work, concerted work with never a stone left unturned. We must be unselfish, forgetting political creeds, as I said before politics can have no place in this movement for good roads. Just so sure as we allow politics to creep in just so sure will we clog the wheels of progress. We must, like true Americans, rise above petty differences of political belief, become thoroughly imbued with the common brotherhood of man and shoulder to shoulder strive for the opening up of this country of ours with a system of public highways that will place us where we belong on this proposition, as we are in all others, the leading nation of the world. I wish it were possible for me to outline a campaign that could not fail; that would mean the speedy solution of this problem, but I can only suggest thoughts which to me strike a vital spot in the opposition and which I hope may be worthy of your consideration.

As I pointed out to you earlier in this talk the theory and practices of good road building and its benefits have been handed down from generation to generation in most European countries; from their youth up the men who were to perpetuate this work acquired the knowledge and the spirit that enabled them to carry on the work of their forefathers. Now we must inaugurate some system that will provide for the teaching of the boys (and I would not eliminate the girls) who will in future years carry on this work. I would have prepared simple text books on practical good road construction, teach them during this character building period of the economic advantages to them

*Address delivered before Good Road Congress, Chicago, Ill., Sept. 28, 1911, by T. W. Gilson, Assistant Secretary, Mitchell-Lewis Motor Company, Racine, Wis.

and the country at large of good roads, roads that are built by the people for the people. These children will take all this to their homes and out of the mouths of the babes and sucklings will come the strongest influence that we can bring to bear. While this educational campaign should be general in our schools, yet I think that perhaps greater stress should be applied to introduce this system into our country schools, working in perfect harmony with the National Grange who have become intensely interested in the good roads movement.

I would go a step farther, I would have introduced and passed in our State legislatures a bill providing for a compulsory course on road building, going into the subject more thoroughly than in the public schools, make these young men who will have had some teaching master the theory and practice of improving and building public highways; imbued them with the idea that it is not for the benefit of the idle rich alone that we should have good roads, but rather that it is today the crying need of our country and they must rally around our banner with the same loyalty and oneness of spirit as they would leap to defend their country's flag.

If this system were put into force immediately, our problem would be largely solved, education of the children will enlighten the uninformed, intelligent voters will be made, there will be no north, no south, right will win and the cause of good roads will triumph.

I have spent two thirds of my life in two states, Vermont and Connecticut; the balance I expect to live out in Wisconsin. Vermont has done nobly, considering her resources, in appropriating money for good roads. Connecticut with her riches has made big strides in this particular during the last seven or eight years. But Wisconsin, last on the list of State Days, I am ashamed to admit it, is nearly last when it comes to good roads. However, we are going to have a reversal of form; we must arouse ourselves and awaken the people of our state to a realizing sense of their duty to their state, their country and themselves. If there is going to be any organized campaign inaugurated by this gathering, come over into Wisconsin and help us. We have a wonderful state, a fine body of citizens who have been misled on this question of building roads by convict labor. We must educate them along right lines, broaden their views, stamp out politics on this one question at least, and I know that future reports from Wisconsin will be all that the most ardent advocate of these measures for which we stand could wish. Before you all I want to pledge myself irrevocably committed to the cause of good roads built by the people for the people.

SEEDTIME AND HARVEST.

The Secretary of Agriculture has directed an investigation to be made concerning the dates of sowing and harvesting and that the results be published in a series of bulletins. The first of these, entitled, "Seedtime and Harvest; Cereals, Flax, Cotton and Tobacco; Dates of Planting and Harvesting in the United States east of meridians 102-104," has just been issued.

"Because southern latitudes are first to feel the advance of spring," says the bulletin, "it is quite natural to suppose that planting and harvesting always move northward with its advance. As a general fact, the progress of sowing and harvesting is northward, but there are interesting exceptions. Of cereals sown in the spring, sowing and harvesting always move in a northward direction, while of those sown in late summer or fall the sowing movement is always southward. Harvesting progresses northward in the case of all cereals except buckwheat. Corn planting progresses northward; winter wheat sowing moves southward. The harvesting of corn and of winter wheat progress northward, but the sowing and harvesting of buckwheat progress southward."

The sections of the United States wherein corn planting begins simultaneously are shown by means of a map crossed by lines extending from east to west. As shown by this map, corn planting begins in southern Florida and in southern Texas about February 15 in normal years. Fifteen days later it is in progress in northern Florida, southern Louisiana, and central Texas, and by May 15 it has progressed as far north as southern Maine, New

Hampshire, and Vermont, central New York, northern Wisconsin, Minnesota, and North Dakota.

"In interpreting the map," to quote further, "it should be remembered that there are many causes which influence the times of sowing and harvesting and, while a line connecting places which sow or harvest simultaneously will run in the main from east to west, there are curious irregularities, deviations here and there, depending primarily upon altitude, rainfall, and character of soil. An increase in altitude is analogous to an increase of latitude and therefore when these lines cross the higher altitudes they will naturally bend toward the south. In regions of great annual rainfall the line will also bend southward, due to physiological peculiarities of plant growth. While the waters of the Great Lakes undoubtedly mitigate the severity of the continental climate in that vicinity, yet they also delay seasonal changes and thus retard spring growth and hence cause a later harvest. This explains why the lines in the vicinity of the Great Lakes are bent southward."

Relative to the rate of progress of corn planting, the bulletin says: "At the starting point, near Brownsville, Tex., planting begins on the average date of February 10. The movement reaches the Texas-Oklahoma line on the mean date of March 12, and therefore crosses Texas in 30 days, or at the rate of 18 miles per day.

"From the time this movement starts at the Texas-Oklahoma line until it reaches the Oklahoma-Kansas line 25 days elapse. The distance from one state line to the other is about 220 miles. Planting, therefore, moves northward through Oklahoma at the rate of 9 miles a day. The rate of progress through Kansas is 10 miles; through Nebraska, 19 miles; through South Dakota, 50 miles; and through North Dakota, 44 miles per day."

The soil temperature at which corn germinates has been ascertained by numerous tests in field and laboratory. The air temperature at which corn planting takes place in actual practice, however, has not heretofore been established, but from data assembled in this bulletin it is believed to be approximately 55 degrees F. Air temperature records at corn planting time in the vicinity of 127 cities east of the Rocky Mountains are given in tabular form.

Compilations of dates of sowing and harvesting by states, by sections of states, and units (tracts 70 miles square), are given for corn, wheat, oats, rye, barley, buckwheat, flax, cotton, and tobacco; maps and illustrations explain the text; and interesting discussions are given of the phenomena of seedtime and harvest.

The Utah State Board of Land Commissioners recently held a special session for the purpose of considering a proposal made by prominent capitalists of Chicago through their attorney, Adolph H. Easter, to purchase outright the Hatchtown and Piute irrigation projects at a reasonable figure. Mr. Easter made a thorough investigation and inspection of the two projects in August, 1910, and upon his return to Chicago presented his views to a number of prominent men of means, who decided to buy both propositions, if the permission of the Utah Land Board and the attorney-general could be secured. A letter to this effect was written to the Secretary of the Board. The attorney-general, to whose attention the matter was brought, ruled that the Land Board has no right to sell the projects in their entirety. The Board, consequently, could not consider the offer and the eastern capitalists were so notified.

The Secretary of the Interior has executed a contract with the Idaho Packing and Provision Company of Boise, Idaho, to furnish fresh meats to the Reclamation in connection with the Boise project, Idaho. The following quantities are to be furnished at prices stated:

80,000 pounds prime fresh beef, @ \$0.076.....	\$6,080.00
7,000 pounds mutton, @ \$0.085.....	595.00
3,000 pounds pork, @ \$0.095.....	285.00

Renew your subscription promptly. The publisher knows that much of the delay is due to carelessness, but much trouble can be avoided by remitting the subscription price promptly in the month the subscription expires.

THE ORIGINATOR OF THE FEDERATION OF TREE-GROWING CLUBS OF AMERICA.

In the spring of 1849 William Greene and wife arrived in San Francisco, having crossed the Isthmus of Panama on their wedding tour. Mr. Greene being in the shipping business, had loaded and dispatched a new clipper ship at New Orleans with a valuable cargo of supplies for San Francisco, then but a distributing point for the newly discovered placer gold fields of California.

The ship was never heard of after leaving the Gulf of Mexico, and this resulted in the bride and groom becoming permanent residents of California.

Mr. Greene was elected the first president of the first board of aldermen of San Francisco and he continued to be one of the leading builders of that great western commonwealth during his life.

Harry Ashland Greene (the subject of this sketch) is one of the four sons born to William Greene and wife, another son being Clay M. Greene of New York, known as the California playwright.

H. A. Greene was born on January 12, 1852, in a large house which his parents had imported from China; native mechanics of that country having been brought with the house to put it together.

During the sixties this Chinese house was occupied by the family of one John Bridges, a man sent to this

only to encourage tree planting but to bring about the enactment of new laws by states, counties and municipalities to prevent further injury to trees already planted, by the telephone, telegraph and electric light companies as a result of their ignorance and carelessness.

The movement proved far more popular than was anticipated.

The next move was the formation of a federation of the tree clubs of the country, so the Federation of Tree Growing Clubs of America was organized with offices in Chicago. H. A. Greene was chosen president and D. H. Anderson secretary. THE IRRIGATION AGE of Chicago was made the official organ of the Federation.

Having failed to provide a revenue to supply funds to carry out the plans of the Federation, one of the greatest movements ever launched in America languished, and hundreds of clubs soon went out of existence from lack of encouragement.

Had the Federation been in a position to send out instructors and organizers in every state, far greater results would have accrued.

The Monterey Tree Growing Club, the parent club, has continued its early prosperity and now has to show in its nursery one of the largest collections of trees in the world. New varieties from all countries are constantly being introduced and their usefulness tried out.

All the gold medals given on the Pacific Coast for forest trees have been won by the Monterey Club. That club, aided by the State University, continues to distribute large quantities of literature and free tree seeds to clubs, colleges and schools, as well as presenting large numbers of trees to public institutions.

Different departments of the United States National Forestry Service have rendered valuable aid to the work of the organization, though, unfortunately, not in a financial way.

The future fate of the Federation is up to the various tree clubs of the country, since the Monterey Club can but inadequately attend to its own business, much less extend it.

It is necessary that the Federation shall be reorganized and placed upon a sound financial basis. Mr. Greene, the president of the Monterey Tree Growing Club, announces his inability to further finance the great work undertaken, nor is it possible for him to add more work to all that he is already doing.

THIS SAVES YOU FIFTY CENTS.

Remit \$3.00 for one year's subscription to THE IRRIGATION AGE and one copy of the "Primer of Hydraulics," cloth bound.

PREPARATION OF THE FIELD FOR IRRIGATION.

Much has been said concerning the increased duty of water, and it has been said that the farmer has been using much more water than is necessary. Most of the articles concerning the duty of water take up the properties of the soil, the manner of cultivation for conservation purposes, the manner of applying water, and show that in a general way all affect the duty of water, and that proper cultivation and proper application of water will increase the duty of water from 100 to 200 per cent.

It has often occurred to the writer that this means very little to the average farmer, in that it does not tell him what he does that he should not do, nor exactly what he might do to increase the efficiency of his water supply.

The thing of first importance to the farmer is the preparation of the field for irrigation. He should see to it that the high spots are removed and that the low spots are filled; in other words, he should see that the surface of his field is smooth, and here is where the ordinary farmer "falls down." After plowing and harrowing his field he perhaps runs a drag over it, and then seeds it, leaving ridges and hollows, holes and knolls, consequently when he irrigates the field it is necessary for him to almost drown the low spots in order to wet the high ones. Water will often be found from one to two feet deep in places in the field. In driving along the road one often sees embankments piled up along low spots to keep the water from flooding the road. If, when the plowing and harrowing are completed, the farmer



Harry Ashland Greene, President American Federation of Tree Growing Clubs.

coast by one of the botanical societies of England to gather plants and seeds, especially those of forest trees. A few years later Bridges was knighted by Queen Victoria for his work, he having been successful in introducing many new plants into England, among them the greatest of water lilies (*Victoria Regia*), from Brazil.

On an exploring tour into the interior of Central America Sir John Bridges was lost and never heard from afterward.

Through Mr. Bridges young Harry A. Greene became interested in trees by working with him in preparing the seed gathered for shipment to England.

Until recent years there has been but little interest taken in trees by the general public, and now there is less known about them even by educated people than of any other important necessity of the human race.

Realizing the general ignorance prevailing regarding the propagation of trees and the inadequate laws existing for their proper protection (particularly those planted on streets and roads), Mr. Greene conceived the idea of starting tree clubs in every community of the country, not

would take a Fresno scraper and take down the knolls and fill up the depressions with the dirt thus removed, in the course of a year or two he would change the field from one hard to irrigate to one exceedingly easy for irrigation, and he would find that practically one-half the amount of water that he was compelled to use in the first place is ample after the field has been smoothed in this way. More than this, he will find that his crops yield better, for when an excess of water is applied to the low spots, the crop at these places in the field is always injured, and it is not an exaggeration to say that as much damage to the crop is done by forcing the water up to the high spots as would be done by allowing these high spots to suffer from a lack of water.

A word of advice now, for the present season will soon be upon us. As you irrigate your fields this spring and summer stake the high spots, driving the stakes down so that they will not interfere with harvesting and mark on these stakes about how much too high the land is at that point; then after the crop is harvested in the fall see to it that these high spots are removed, and, after plowing, smooth the surface with great care. When you stop to consider that this work is a permanent improvement and need not be done year after year, when once it has been accomplished, and when you consider that during every dry year the crops are injured for lack of water, it seems that every intelligent farmer would realize the fact that it will be a paying proposition to thoroughly prepare his ground so that it will irrigate in the best possible manner. See to it that the plowed field is in a perfect state of tilth before the seed is planted, for this careful preparation is what will put the bushels into the bin in the fall.

E. B. House, Colorado Agricultural College, Fort Collins, Colo.

SOIL SURVEY WORK.

The Department of Agriculture, through the Bureau of Soils, is cooperating in a soil survey investigation with the state governments of Alabama, Kansas, Mississippi, Missouri, New Jersey, New York, North Carolina, Pennsylvania, Washington, West Virginia, Wisconsin and Tennessee. Prof. Whitney, chief of the Bureau of Soils, in a statement to Secretary Wilson, says: "This cooperative soil-survey work has been very useful to the bureau in bringing to our aid and assistance men having a thorough knowledge of local conditions, and it has been of assistance to the states in bringing to them the aid of men who have a wider and more extensive knowledge of national conditions, or, in other words, of soil conditions beyond the borders of the state.

"This cooperative work should be encouraged and more funds should be made available to meet the increasing demands for its extension. At the same time it must not be forgotten that there are over 30 states that are not cooperating in which there is a very strong demand from citizens and associations for knowledge regarding their soil resources, and from the federal viewpoint it is just as important to study the soil resources and map the soils in these states as it is in states where cooperation can be arranged. Additional funds are greatly needed for the extension of soil-survey work in the non-cooperating states."

SUMMARY REPORT OF THE FARMERS' INSTITUTE WORK.

The 1911 annual report of the director of the Office of Experimental Stations has been submitted to Secretary Wilson. An interesting feature of the work of the office is a review of the Farmers' Institute work.

Reports were received during the past year from 44 states and territories giving data respecting their institute work. In 41 of these, regular institutes were held to the number of 5,582; 3,723 were one-day meetings, 1,704 two days, and 155 three days or more.

The total number of sessions was 15,532, with an aggregate attendance of 1,904,676. If the states and territories not reporting equal the sessions and attendance of last year, the aggregate number of sessions for the entire country will amount to 16,545 and the attendance to 2,074,099, as against 16,586 sessions in the previous year and 2,395,808 attendance, a falling off in sessions of 41

and in attendance of 321,709. The special institutes aggregated an attendance of 1,252,933, making the entire attendance at institute meetings of all kinds 3,327,092, or 383,848 more than in 1910. The special institutes are rapidly growing in importance and interest. One hundred and forty-nine movable schools were held with an attendance of 39,965; 62 railroad instruction trains were run, covering 35,705 miles, accompanied by 740 lecturers and attended by 939,120 persons. Four hundred and fifty-nine independent institutes were held, with an attendance of 130,917, and 15 round-up institutes, continuing through 153 sessions, attended by 22,730 persons. There were 303 picnics and conventions, consisting of 269 sessions, attended by 120,161 persons.

DRAINAGE PROPOSITIONS INVESTIGATED.

The annual report of Dr. A. C. True, director of the Office of Experiment Stations, to Secretary Wilson shows a great amount of drainage work done by his office. In treating with the subject the director says:

"The following projects of survey drainage have been completed and are in course of construction:

"Arkansas—Black River levees. Delaware—Redden farm. Georgia—McRae farm. Kentucky—Marrs farm. Maryland—Bureau of Animal Industry farm, Princess Anne Academy farm. Mississippi—Tuscumbia river, Walnut Grove plantation, Rogers farm, Bolivar county drainage district. Nebraska—Elkhorn river bench lands. North Carolina—Chadbourn drainage district, Pantego drainage district, Broad Creek drainage district, Pender county test farm, Lyon swamp canal, and Cape Fera river levee. South Dakota—Vermilion River drainage district. Texas—Barstow district. Vermont—Morgan horse farm. Virginia—Truck experiment station farm, Berkeley swamp.

"Reclamation of lands subject to overflow, as by floods: Alabama—Little Hurricane creek. Nebraska—Bench lands of Upper Elkhorn river. Oklahoma—Black Bear creek.

"Reclamation of lands continually wet (swamps, marshes, etc.): Arkansas—Crooked Bayou drainage district. Mississippi—Belonzi drainage district. North Carolina—Back swamp and Jacob swamp. South Carolina—Little Wambaw swamp.

"Improvement of natural water courses or construction of new channels to provide outlets: Georgia—McRae Branch. North Carolina—Third creek and Fourth creek. Haw river. Virginia—Chickahominy river.

"Farm drainage: Arkansas—Penitentiary farm. Georgia—McRae farm. Maryland—Bureau of Animal Industry farm. Mississippi—Rogers farm, Walnut Grove plantation. North Carolina—Pender County test farm, Edgecombe County test farm. Red Crest test farm. South Carolina—James Island, Clemson College farm. Virginia—Sterling demonstration farm, Arlington experiment farm.

"Drainage of irrigated lands: Colorado—Grand River Valley, San Luis Valley, Arkansas River Valley. Idaho—Payette and Boise River Valleys, Drainage District No. 1. New Mexico—Pecos Valley. Texas—Lower Rio Grande Valley. Utah—Various tracts in several counties. Washington—Spokane County, Yakima Valley, including Moxee Valley. Wyoming—Big Horn Basin, including Grey Bull Valley; Shoshone Valley.

"Alabama—Prairie lands. California—Lands injured by alkali in Orange County. Georgia—Effingham County, Telfair County. Maryland—River bottom lands in Montgomery County. Massachusetts—Green Harbor River marsh lands. Missouri—Wyaconda River. North Carolina—Flea Hill drainage district, Salem Creek, Beaver Dam Swamp, Brown Marsh. South Carolina—Sumter, Levy Bay, Wappaoola plantation, Dean Hall plantation, Wadmalaw Island, Switzerland, Great Pedee River. Virginia—Drainage District No. 1, Newport News, Meherrin River."

ENGINEERING FOR LAND DRAINAGE.

This is the title of a new book by C. G. Elliott, C.E., Chief of Drainage Investigations of the U. S. Department of Agriculture, and is especially designed as a hand-book for engineers working out the various problems of land drainage. The book contains 23 chapters and many tables and illustrations.

Continued on page 156.

THE PROCESSION OF THE AGES.

On first thought it would seem difficult to crowd centuries into a Saturday afternoon, but this feat was actually accomplished last Saturday, November 11th, on the 500-acre farm, which covers the area immediately beyond the great plant of the Oliver Plow Works as you look southwest toward the open country from the railroad station at South Bend, Indiana.

Here it was that the procession of ages wended its way across the field and was caught in one motion picture

ing three 14-disk Deering harrows and three 12-marker Keystone grain drills.

We never saw the grand caravan with its many teams of camels and elephants that once made its majestic and pompous journeys from St. Petersburg to Peking, but we venture to say that the International and Oliver procession rivaled any procession of caravans of former times.

The back yard of the great plow plant, as the Oliver farm is known, was the scene of the world's greatest



Three 45-Horse Power Mogul Gasoline Tractors Pulling Fifty-five Plows.

that can be projected on the screen in fifteen minutes' time. The procession consisted of a wooden mold-board plow used in the days of the Revolution and for many years owned by Daniel Webster; a one-horse Oliver Goober steel beam chilled plow; the Famous Oliver No. 40 chilled plow; the James Oliver No. 11 sulky plow; the Oliver No. 28 medium lift sulky plow; the Oliver No. 1 high lift sulky plow; the Oliver No. 1 center draft high lift gang plow; the Oliver No. 22 low lift gang plow; the International 20-horse power tractor pulling six 14-inch plows; one 45-horse power Mogul pulling ten 14-inch plows; one 45-horse power Mogul pulling twelve 14-inch plows; one 45-horse power IHC 'Mogul gasoline tractor pulling eighteen 14-inch plows; and three 45-horse power IHC Mogul gasoline tractors pulling fifty-five 14-inch plows, and an IHC tractor pull-

triumph in agriculture. The great Mogul gasoline tractors stood three abreast in front of a long row of shimmering steel—not of bayonets—but of shining plow shares; the engines seemed to be actually fretting—champing at the bits, as it were—to get under way; the mufflers were sounding the reveille—not to summon battalions of soldiers to arms, but to herald abroad man's conquest over nature. Finally, everything is in readiness and the field marshal gives the signal and they are off in a "bunch," marking time with the chug! chug! chug! of the mufflers, and move forward with a precision and stateliness that rival the King's own guards.

This outfit plowed fifty-five furrows, 14 inches wide, or 64.16 feet. On the spur of the moment, one would think this great outfit would be unwieldy, but the truth is that



Utah Lake—A Vast Water Supply—Utah Valley.

corners were turned and the plows thrown out and in the ground with no more difficulty than is experienced in operating the ordinary traction plowing outfit. One or more sections of the plows could be detached in a moment, and the outfit could move forward without readjusting the hitch. The long gang was made up by connecting eleven sections, each section having five plows, and the sections were hitched together in a way that permitted the plows to follow the contour of the field easily and with an evenness in depth that was as surprising as it was uniform. One prominent citizen, who met the Moguls half way down the field, hailed us with the terse interrogative—"Are you going to plow the whole township at one lick?"

Perhaps you wonder how the engines could be successfully hitched to such a long gang of plows—but it's all very simple—after you know how. The hitch works on the principle of the block and tackle. Six pulleys are connected with the platform behind which the plows are attached. The hitch on each of the three engines consists of two pulleys. A chain is passed around these pulleys and fastened to each end of the platform. It will thus be seen that this hitch prevents any one of the engines taking more load than another, and also insures the flexibility required to turn the corners.

Another singular feature about this outfit is the position of the engines with relation to the gang of plows. If we did not stop to figure out the center of draft, we would be sure to believe that the engines should be hitched nearer the center of the long line of plows, but the engineers figured out this feature of the problem very carefully and found that the center of draft made it necessary for them to hitch the engines as shown in the illustration. In other words, the plows on the land side are so far in the rear that they come more nearly being directly behind the engines than they appear to be.

Hardly had the ink dried on the announcement that fifty 14-inch plows had been drawn by three 60-horse power engines, thus marking an epoch in agriculture, when these three 45-horse power Mogul gasoline tractors pulled fifty-five plows, carrying the stupendous load easily and without a whimper, other than the staccato chugs resounding from the mufflers.

Following the plows from one end of the field to the other, we noticed a high ridge at each end of the field and on inquiry learned that the field in which we were working was once the private race course of James Oliver, where he found much pleasure in driving his thoroughbred horses. Although Mr. Oliver lived until a few years ago, he never dreamed that it was possible to successfully operate such a gigantic plowing outfit.

Who can say how much this great lesson means to agriculture and to the progress of civilization? Plowing is not so much the peak load of agriculture as it is the foundation upon which rests the whole superstructure of agricultural production. Good plowing and good tillage—and there can be no good tillage without good plowing—largely determine the yield of our cereal crops—and therefore fix the price of bread. The high or low cost of living is largely determined by the manner in which our fields are plowed. Think of plowing an acre in less than four minutes, or more than fifteen acres an hour—150 acres a day! It may not be far out of the way to call this plowing outfit the realization of the dream of "The Man with the Hoe." The McCormicks, the Deerings and the Olivers made this dream come true, and to them belongs the wreath of laurel, for they have lessened the cost of bread.

THE AUTO WAGON AS AN AID TO THE FRUIT GROWER.

Wonderful progress has been made in the improvement and development of motor-driven vehicles in the past decade. They have passed through the experimental stage, and have been placed on a practical basis. It is a demonstrated fact that the motor-driven vehicle of today gives service that cannot be obtained from a flesh and blood animal.

That a motor-driven vehicle is a profitable investment for the modern business man is no longer a matter of conjecture—it is a conceded fact. The questions that confront the prospective purchaser of the motor truck are: Which truck is best adapted to my business? Will give the best service? Is simple in construction and operation? Can be operated with least expense? Will best meet the required



The Auto Wagon as an Aid to the Fruit Grower.

road conditions? Give satisfactory service the year round? Is sold at a reasonable price? These questions he must answer for himself after studying his conditions, and after a careful investigation of the different makes of cars on the market.

Mr. Isaac E. Andrus, a fruit grower at Missoula, Mont., was confronted with a problem of this kind. His deliveries could not be made with the equipment he had. To buy additional horses would mean much additional expense, because horses must be fed whether they are in use or not. He solved the problem by purchasing a motor-driven vehicle.

Mr. Andrus says: "Owing to my rapidly growing trade in the city, requiring several trips daily, each trip covering from seven to ten miles, I found it necessary to either increase the number of horses and vehicles or purchase something more speedy.

"After careful deliberation, I purchased in June an auto wagon for use in delivering the products of my twenty-acre fruit and produce farm. I can safely say that, as a business proposition, I consider it one of the best I ever made, for I can now handle my business with speed and comfort. My best record, however, was made on November 23, when I made six trips into the city, covering a distance of more than forty miles, and handling more than 7,000 pounds of packaged fruit."

The experience of Mr. Andrus goes to show that the motor-driven vehicle is a paying proposition, not only from the standpoint of dollars and cents, but from the standpoint of comfort, and the satisfaction it gives to the owner of knowing that his fruit and produce is being handled with the least possible delay.

CALIFORNIA'S IRRIGATION STATISTICS.

The total number of farms irrigated in 1909 was 39,352, against 25,675 in 1899, an increase of 13,677, or 53.3 per cent. Between 1899 and 1909 the number of all farms in the state increased 21.6 per cent. The per cent irrigated of the whole number of farms in 1909 was 44.6. In 1899 the per cent was 35.4, showing an increase in per cent of 9.2 during the 10 years.

The total acreage irrigated in 1909 was 2,664,104 acres, against 1,446,114 acres in 1899, an increase of 1,217,990 acres, or 84.2 per cent. The total acreage which all enterprises were capable of irrigating in 1910 was 3,619,378 acres, an excess of 955,274 acres over the area irrigated in 1909. The area included in projects either completed or under construction in 1910 was 5,490,360 acres, an excess of 2,826,256 acres. This indicates in a general way the area which will be available within the next few years for the extension of irrigation, and shows that the area irrigated in 1909 can be more than doubled without the construction of additional works.

The number of independent enterprises reported in 1910 was 13,970. The total length of all ditches was 21,129 miles, of which 12,599 miles were in main canals and 8,530 miles in laterals. The length of main canals reported in 1899 was 5,106 miles, showing an increase in the 10 years of 7,493 miles, or 146.7 per cent. The number of

reservoirs reported was 1,604, having a combined capacity of 743,269 acre-feet. The number of wells pumped for irrigation was 10,710, and the number of all pumping plants was 9,267. The engine capacity of pumping plants was 123,590 horsepower. The acreage irrigated with pumped water was 309,134 acres. Flowing wells supplied water to 55,818 acres.

The total cost of irrigation systems reported in 1910 was \$72,445,669, against \$19,181,610 in 1899, an increase of \$53,264,059, or 277.7 per cent. The average cost per acre was \$20.02 in 1910, against \$13.26 in 1899, an increase of \$6.76, or 51 per cent. The average cost of operation and maintenance per acre in 1909 was \$1.54.

The acreage irrigated in 1909 has been classified according to the state and federal laws under which the works were built or are operated, as follows: United States Reclamation Service (act of Congress June 17, 1902), 400 acres, or less than 1 per cent of the total; United States Indian Service (various acts of Congress), 3,490 acres, or 0.1 per cent of the total; irrigation districts, 173,793 acres, or 6.5 per cent; cooperative enterprises, 779,020 acres, or 29.2 per cent; commercial enterprises, 746,265 acres, or 28 per cent; and individual and partnership enterprises, 961,136 acres, or 36.1 per cent. United States Reclamation Service works are to be turned over to the water users for operation and maintenance as soon as they are paid for. Including these, 71.8 per cent of the acreage irrigated in 1909 was supplied by works controlled by the water users.

Streams supplied 2,265,032 acres, or 85 per cent of the total acreage irrigated in 1909; lakes supplied 18,470 acres, or 0.7 per cent; wells supplied 332,413 acres, or 12.5 per cent; springs supplied 31,779 acres, or 1.2 per cent; and reservoirs supplied 16,410 acres, or 0.6 per cent.

POINTS OF INTEREST FROM WYOMING.

To people accustomed to thinking of Wyoming as practically a barren plain, a visit to any one of the many orchards in any irrigated district of the state would be a revelation.

Within five miles of Lander is located one of the finest fruit farms in the Rocky Mountains, yet but few people even know there is such a place. It is the experiment station of the state of Wyoming, surmounting a high bluff on the Popo Agie river, a short distance from the road. No one traveling on the road, however, would have the slightest suspicion of the proximity of such an orchard. An army might pass without being aware that within a stone's throw is enough fruit to feed a division.

There are more than 1,300 trees in this orchard and this year will show an abundant yield of over one hundred varieties of apples, pears, plums and cherries.

A complete record of all kinds of fruit is kept at this farm, and before long it will be possible to know just what kinds are adapted to this climate. Already it has been determined that Hibernial, Duchess, Wealthy, and Yellow Transparent apples; Idaho, Bartlett and Sickle pears, and Weaver, Burbank and Aitkins plums thrive well in this country.

There are 21 varieties of crab-apples and all are prolific. Two trees bearing a fruit which is a cross between a plum and a cherry are always heavily laden with fruit in the bearing season.

Many of the trees are so heavy with fruit that the limbs bend to the ground. One little two-year-old apple tree had thirty-nine large perfect apples of the Wealthy variety.

The Big Horn Basin is conceded by those who have investigated the subject to have a great future in the apple world. With excellent water and air drainage, a sandy loam and volcanic ash soil, 300 sunshiny days in the year, no fruit or tree pests, apples grow and attain a flavor, color and size that few other districts in the United States can equal.

There has never been an apple crop failure in the Basin and this year the trees are loaded with fruit.

During a wind storm not long ago two hundred or more apples were blown from a tree in Cody and yet it is as full as it can hold, the branches bending far down with the luscious fruit.

PROTECTION OF WATER SUPPLY OF TOWNS AND CITIES.

Secretary Wilson has decided that the interests of cities and towns which obtain their water from streams having their water sheds within national forests call for special measures of protection, and he has therefore developed a plan of coöperation for the department of agriculture with those communities which are alive to the importance of keeping their water supply pure.

There are many western towns and cities, some of them of large size, which derive their water from drainage basins lying inside the national forests. One of the recognized objects of forestry is to insure the permanence and protect the purity of municipal water supplies. As the forests are maintained for the benefit of the public, Secretary Wilson considers it the duty of his department to do all that it can both to prevent the pollution of such supplies and to create or maintain conditions most favorable to a constant flow of clear water.

Stock raising and occupancy of the land for the various kinds of use which are ordinarily encouraged on the national forests may be highly undesirable if allowed on drainage basins which are the sources of drinking water. There is also to be considered the injury which may be done if the water is silt-laden. By protecting and improving the forest cover and by enforcing special regulations to minimize erosion and to provide for the maintenance of sanitary conditions, the government will try to safeguard the interests of the public.

A form of agreement has been drawn up, providing that, when coöperation is entered into between the secretary of agriculture and any city desiring conservation and protection of its water supply, the secretary will not permit the use of the land involved without approval by the town or city except for the protection and care of the forests, marking, cutting, and disposing of timber which the forest officers find may be removed without injury to the water supply of the city, or for the building of roads, trails, telephone lines, etc., not inconsistent with the objects of the agreement, or for rights of way acquired under acts of Congress. The secretary also agrees to require all persons employed on or occupying any of the land both to comply with the regulations governing national forests and to observe all sanitary regulations which the city may propose and the secretary approve.

The agreement provides for the extension and improvement of the forests on the part of the government by seeding and planting and the best methods of silviculture and forest management, so far as the funds available will permit. The city on its side is expected to assist in the work by paying the salaries of the additional guards necessary to carry out the agreement, and in case extensive forest operations are immediately desired by the city, it would bear the major part of the cost entailed by this work.

At a recent meeting held in Chinook, Mont., the Milk River irrigation project was discussed. This project will embrace 250,000 acres of land and it is estimated that the cost per acre will be about \$10. Water will be taken from St. Mary's lake. The canal when completed will be twenty-eight miles long and will empty St. Mary's water into Milk river, which will furnish water for thousands of acres.

A tract of land embracing about 2,000 acres forty-five miles west of Roswell, N. M., will be watered in the near future from El Macho.

Construction of the Chuckawalla dam across the Colorado river at a point forty miles north of Needles, Ariz., will be commenced in about six months. The plans include an intake dam and settling reservoir about fifteen miles above Ehrenberg. Plans call for fifty miles of initial canals to distribute the water over 300,000 acres. A. H. Koebig, of Los Angeles, Calif., is the engineer in charge of the construction work, and he states that it will take about 5 years to complete the project. The company which will undertake the work is capitalized at \$10,000,000.

THE PRIMER OF HYDRAULICS*

By FREDERICK A. SMITH, C. E.

6. The Composite Section.

To compare the composite section with the true circular one, let us solve the last problem for the composite section.

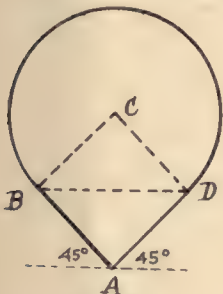


Fig. 91.

VI, under slope .0002, we find C opposite $\sqrt{r} = 1.8 = 120.50$, and with the adjustment noted in the preceding paragraph gives us $C = 121.9$, hence:

$$v = 121.9 \times 1.87 \times .0162 = 3.79 \text{ sq. ft. per second.}$$

The total capacity then will be:

$$116.58 \times 3.79 = 444.84 \text{ cu. ft. per second.}$$

It may be noted that the velocity is the same in the 12 ft. circular and 12 ft. composite section, but there is a material gain in capacity, due to the greater flow area.

Another advantage of the composite section lies in the fact that for dry weather flow it gives much more satisfactory velocities than the circular section; this will well be illustrated in one of the following applications:

7. Find flow area and velocity.

Suppose the 12 ft. composite sewer is to take care of dry weather sewage flow of 40 cu. ft. per second; find flow area and velocity, assuming same slope as above.

From table XVI select a random depth, say .3, which would mean a depth of $12 \times .3 = 3.6$ ft.; the area constant opposite .3 = .090, and hydraulic radius constant = .108; hence flow area = $.09 \times 144 = 12.96$ sq. ft., and hydraulic radius = $.108 \times 12 = 1.296$, and $\sqrt{r} = 1.14$.

Refer to table VI under slope .0002 and opposite $\sqrt{r} = 1.0$, we have $C = 96.11$; opposite $\sqrt{r} = 1.2$ we have $C = 103.98$; this shows a difference of 7.87 for .2, or .3935 for 1/100; hence for .14 we should add $14 \times .3935 = 5.51$ to 96.11, which gives $C = 101.62$; hence $v = 101.62 \times 1.14 \times .0162 = 1.88$ ft. per second. Multiply this with 12.96 gives = 24.37 cu. ft. flow, which is not enough, as we require a flow of 40 cu. ft. per second.

Next try a depth of .407; from table XVI we find area constant .1654, and r constant = .1449; multiply this by 12, we get:

$$R = 12 \times .1449 = 1.74 \text{ and } \sqrt{R} = 1.32.$$

$$\text{Area} = 12 \times 12 \times .1654 = 23.82 \text{ sq. ft.}$$

Refer to table VI. Under slope .0002 opposite $\sqrt{R} = 1.2$ we find $C = 103.98$.

$$\text{Opposite } \sqrt{R} = 1.4 \text{ } C = 110.51.$$

Difference = 6.53 for .2; for 1/100 .3265, hence for .12 we must add $12 \times .3265 = 3.92 = 107.90$.

$$\text{Now } v = 107.9 \times 1.32 \times .0162 = 2.306 \text{ ft. per second.}$$

$$\text{Multiply this by } 23.82 \text{ gives } 54.92 \text{ cu. ft. per second.}$$

This is too much, but we established limits for the flow height.

Next try in table XVI a depth of .387; the area constant is .1497.

R constant = .13723; multiply by 12 gives $R = 1.65$ and $\sqrt{R} = 1.28$. Area = $.1497 \times 12 \times 12 = 21.557$ sq. ft.

From table VI find C for $\sqrt{R} = 1.28$, as explained above, gives us $C = 106.62$.

$$v = 106.62 \times 1.28 \times .0162 = 2.21 \text{ ft. per second.}$$

$$\text{Multiply } 2.21 \text{ by } 21.557 = 47.62 \text{ cu. ft. per second.}$$

This is still too large, but gives a very good idea about

the depth of flow; for accurate work we will try another depth.

Take .367 in table XVI; area constant = .1347, R constant = .1298; multiply by 12 gives $R = 1.56$; $\sqrt{R} = 1.25$; area = $.1347 \times 12 \times 12 = 19.397$ sq. ft.

From table VI find C for $\sqrt{R} = 1.25 = 105.61$.

$$\text{Then } v = 105.61 \times 1.25 \times .0162 = 2.14 \text{ ft. per second.}$$

$$\text{Multiply } 19.397 \text{ by } 2.14 = \text{gives } 41.51 \text{ cu. ft. per second.}$$

This Answer fulfills the condition; so the Composite Section has a flow depth of $.367 \times 12 \text{ ft.} = 4.4 \text{ ft.}$, and a velocity of 2.14 ft. per second; which is sufficient to prevent sedimentation.

8. Comparisons between Circular and Composite Sections.

For very small quantities the composite section gives better velocities than the circular; to illustrate, find velocity and flow area for a flow of 8 cu. ft. per second in a conduit 12 ft. in diameter. For the composite section, assume depth .18; then area constant = .0324 and R constant .0648. Then $R = .78$ and $\sqrt{R} = .88$; the flow area = 4.67 sq. ft.

From table VI find C for $\sqrt{R} = .88 = 90.35$ and $v = 90.35 \times .88 \times .0162 = 1.29$ ft. per second.

Multiply 4.67 by 1.29 = 6.02 cu. ft. per second, which is not enough. Assume depth .2, area constant .04, R constant .072; then $R = .864$ and $\sqrt{R} = .93$, and flow area 5.76.

Find C in table VI for $\sqrt{R} = .93 = 92.83$, and $v = 92.83 \times .93 \times .0162 = 1.40$ ft. per second.

Multiply 5.76 by 1.40 = 8.06 cu. ft. per second, which just covers the case, giving a depth of flow of 2.4 ft. and a flow velocity of 1.4 ft. per second.

To find the depth of flow and velocity in the circular sewer of 12 ft. diameter, we may assume that the velocity will not exceed 1 ft. per second—then the flow area will be 8 sq. ft. Since the area of a segment equals d^2 times area constant, the area constant equals area divided by d^2 ; hence divide 144 into 8, which gives area constant = .055; in table XV we find area constant = .05338 and R constant = .0754; then $R = .905$ and $\sqrt{R} = .951$; area of segment = $.05338 \times 144 = 7.69$ sq. ft.

Then in table VI find C under slope .0002 = 91.53 for .90 for $\sqrt{R} = 1.0$; $C = 96.11$, so C for .95 will be half way between 91.53 and 96.11 or 93.82.

Then $v = 93.82 \times .95 \times .0162 = 1.44$ ft. per second. Multiply this with 7.69 gives 11.07 cu. ft. per second, which is too much.

The above trial corresponded to a versed sine of .12 let us try .09; then the area constant = .03501 and R constant = .0574, hence, $R = .69$, $\sqrt{R} = .83$, and area of segment 5.04 sq. ft.

In table VI we find C for $\sqrt{R} = .83 = 87.9$, and $v = 87.9 \times .83 \times .0162 = 1.18$ ft. per second. Multiply 5.04 by 1.18 = 5.95 cu. ft. per second. This is not enough. Let us next try versed sine .1; the area constant is .04087, R constant .0635, hence $R = .762$ and $\sqrt{R} = .873$, and area of segment 5.885 sq. ft.

The factor C for $\sqrt{R} = .87 = 89$.

$$v = 89.0 \times .87 \times .0162 = 1.25.$$

$$\text{Multiply } 5.89 \text{ by } 1.25 \text{ gives } 7.36 \text{ cu. ft. per second.}$$

This is not quite enough, but shows that the versed sine is slightly greater, but, we know that the versed sine of .12 is too great, and the real one is a very small fraction over .1, perhaps .105.

The solution shows, however, that while we have a velocity of 1.40 ft. per second in the composite section, we have only a velocity of slightly more than 1.25 ft. per second in the circular conduit.

1. General Deductions.

Whenever flow of water in a pipe is produced by pressure the head equivalent to such pressure can be readily computed. For instance, where the pressure is given as 20 lbs. per square inch it is equivalent to the height of a column of water producing 20 lbs. pressure per square inch. It requires a column of water 2.309 feet high with a cross-section of 1 sq. in. of water to produce a pressure of 1 lb. on its base; hence 20 lbs. pressure would be equivalent to a water column of $20 \times 2.309 = 46.18$ ft.; if such a pipe would have a length of 3,000 ft. then the head would be 46.18 ft. in 3,000 ft. and the factor $s = 46.18 \div 3,000 = .01539$.

In general let l = length of pipe,

p = pressure in pounds per square inch,

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h = head in feet,
 d = diameter of pipe and
 s = sine of slope,

then $s = h \div l$,

$h = 2.31p$,

hence $s = 2.31p \div l$.

As the pipes are constantly filled, $R = d/4$. If we transform the fundamental formula

$$v = C \sqrt{Ks}$$

by substituting above values for R and s we obtain:

$$v = C \sqrt{d/4 \times 2.31p \div l}$$

$$v = C \sqrt{2.31pd \div 4l}$$

Simplifying we obtain:

$$v = \frac{C}{2} \sqrt{2.31pd \div l} \quad (1)$$

From this formula we can develop any one factor when all the others are known, thus we can find the pressure p necessary to produce a certain velocity:

$$p = 4lv^2 \div 2.31C^2d \quad (2)$$

also find the diameter of a pipe to produce a given velocity under a given pressure and for a given length of pipe:

$$d = 4lv^2 \div 2.31C^2p \quad (3)$$

also find the length l when all the other factors are given:

$$l = 2.31C^2dp \div 4v^2 \quad (4)$$

and lastly the constant C may be determined if all other factors are known:

$$C = \sqrt{4lv^2 \div 2.31pd} \quad (5)$$

These formulas are very simple and extremely useful in determining the different requirements of hydraulic problems.

Since $h = 2.31p$, then $p = \frac{h}{2.31}$ or $p = .433h$.

This shows that the head under which a certain pipe is flowing can be reduced to pressure in pounds per square inch by multiplying the head in feet by the constant .433.

Thus the pressure in a pipe, in which the water is flowing under a head of 10 ft. would amount to $10 \times .433 = 4.33$ lbs. per square inch.

KANSAS IRRIGATION STATISTICS.

This is a preliminary comparative summary submitted by Dr. Le Grand Powers, chief statistician of the division of agriculture in the Bureau of the Census, under whose supervision it was prepared by R. P. Teele, special agent in charge of irrigation. This summary shows for both 1909 and 1899 the number of farms irrigated, the acreage irrigated, the length of main ditches, the total cost of irrigation systems, and the average cost per acre irrigated. It shows also, for the year 1909, the acreage which existing enterprises are capable of supplying, the acreage included in existing projects, the number of independent enterprises, the length of lateral ditches, number of reservoirs, capacity of reservoirs, number of flowing wells, number of wells pumped for irrigation, the number of pumping plants, engine capacity of pumping plants, acreage irrigated with pumped water, and the average annual cost of maintenance and operation. The acreage irrigated is classified by the type of enterprise supplying water and by the source of water supply.

It should be noted that the figures are subject to revision, after more complete tabulation, but it is not expected that there will be any material modification of the totals or percentages reported.

The total number of farms irrigated in 1909 was 1,006, against 929 in 1899, an increase of 77, or 8.3 per cent. Within the same period the number of farms in the state increased but 2.4 per cent. The per cent of the whole number of farms irrigated in 1909 was 0.6 and in 1899 it was 0.5, showing that in neither year was irrigation an important factor in Kansas agriculture.

The total acreage irrigated in 1909 was 37,479 acres, against 23,620 acres in 1899, an increase of 13,859, or 58.7 per cent. During the same period the improved land in farms increased but 19.2 per cent. The irrigated area extended more rapidly than the improved area, although the percentage of the improved land irrigated is so small at both census periods that it is almost negligible.

The total acreage which all enterprises were capable of supplying with water in 1910 was 139,995 acres, an excess of 102,516 acres over the area irrigated in 1909,

showing that the area irrigated can be more than doubled without the construction of new works. The acreage included in projects completed or under construction in 1910 was 161,300 acres, an excess of 123,821 acres over the area irrigated in 1909. This indicates, in a general way, the area of irrigated land which will be available for settlement within the next few years.

The number of independent enterprises in 1909 was 716, against 706 in 1899, an increase of 10, or 1.4 per cent. The length of ditches reported in 1909 was 281 miles, against 324 in 1899, a decrease of 43, or 13.3 per cent. In Kansas many enterprises have been abandoned from time to time, while new ones have been taken up. The enterprises reported in 1909 are, consequently, not necessarily the same as those reported in 1899. This accounts for the decrease in length of ditches with an increase in the number of independent enterprises.

The number of reservoirs in 1909 was 42, with a combined capacity of 31,024 acre-feet. But three flowing wells used for irrigation were reported. The number of pumped wells used for irrigation was 939, and the number of pumping plants 684. Two enterprises reported central power plants with large numbers of wells pumped. This accounts for the excess in the number of wells over the number of pumping plants. The engine capacity of pumping plants, excluding windmills, was 1,112 horsepower. The acreage irrigated with pumped water in 1909 was 1,979 acres. This does not include the acreage under the Garden City project of the United States Reclamation Service, which received water from both the Arkansas River and pumped wells. These wells were operated in 1908 and 1909, but have not been used since, and this land has received only river water since 1909.

The total cost of irrigation systems to July 1, 1910, was reported as \$1,365,563, against \$529,755 in 1899, an increase of \$835,808, or 157.8 per cent. The average cost per acre to which enterprises were ready to supply water in 1910 was \$9.75. The area under ditch was not reported in 1899, but the average cost per acre actually irrigated in 1899 was \$22.43, or \$12.68 more than the average per acre under ditches in 1910. Several large ditches built in Kansas prior to 1899 never were used to their full capacity and were largely abandoned at that time. This made the average cost per acre actually irrigated much higher than it would have been otherwise.

The average annual cost per acre for operation, and maintenance in 1909 was \$1.59.

The acreage irrigated in 1909 has been classified according to state and federal laws under which the works were built or are operated, as follows: United States Reclamation Service (act of Congress June 17, 1902); 6,953 acres, or 18.6 per cent of total; cooperative enterprises, 27,372 acres, or 73 per cent; individual and partnership enterprises 3,154 acres, or 8.4 per cent of total.

Streams supplied 35,489 acres, or 94.7 per cent of the total acreage; wells supplied 1,961 acres, or 5.2 per cent; springs supplied 27 acres, and reservoirs 2 acres. The area credited to the United States Reclamation Service received a partial supply of water from the Arkansas River through a cooperative canal, and during the seasons of 1908 and 1909 an additional supply from wells operated by the United States Reclamation Service. These wells have not been in use since 1909, and this area now receives its entire supply through the cooperative canal. This area has been classified as receiving its water from streams rather than from wells.

AMERICAN DAIRY INSTITUTE.

One of the most important educational conventions held in connection with the National Dairy Show, Chicago, was the American Dairy Institute. This meeting was important in that a number of matters regarding the growing of alfalfa, and its relation to the fertility of the soil, were brought out by Dr. Cyril G. Hopkins, professor of agronomy, University of Illinois, who is one of the best known authorities in the country.

The matter which is not of common knowledge was brought out in the statement made by Dr. Hopkins, that it is a mistaken idea that alfalfa enriches the soil. Large yields require a great amount of fertility and will impoverish the soil very rapidly unless fed to live stock and returned to the soil. The idea that alfalfa enriches the

soil probably comes from the fact that in many instances the soils have been growing large crops for many years and the crops following alfalfa do better than those following non-leguminous crops. This is due to the fact that alfalfa extends its roots many feet into the ground, utilizing the fertility not reached by the roots of other plants, and putting the soil in good physical condition.

The foregoing is but one of the many lessons which were taught to those who attended this year's National Dairy Show. The trip to the show amply repaid all of those who went to Chicago. As the educational features of the show will be broadened in 1912, it would be well for those who are interested not only in dairying but in the growing of alfalfa, corn and the other farm crops which are of general importance in dairy husbandry, to make up their minds to attend.

"A perfect soil is one which contains the ingredients in perfect proportions; sand, to enable it to absorb air and moisture in proper amounts, and to render it warm and friable; clay, to keep it cool, and prevent a too rapid leaching or evaporation of water; lime, to assist in the decay of vegetable matter, and organic matter to retain the best amount of moisture, and to furnish material for the various chemical processes continually going on in good soils."

These perfect conditions seldom occur in nature, although it is in the power of man to produce them. But perfect soils are not to be had without great labor and care, and generally it is more important for the farmer to adapt himself to his soil and make it produce the best it is capable of doing than to attempt to change its character.

It is of prime importance for the farmer to study his soil and learn its characteristics, for every kind of soil calls for a little different treatment, and an intelligent practice must be based on definite information regarding the needs of his particular soil.

That the manufacture of cement is an American industry is shown by the fact that while our production last year was over 75,000,000 barrels our imports were only 306,863 barrels. Our exports were 2,475,957 barrels. About 60,000 acres are embraced in this project.

AN INTERESTING TABLE.

The following is the reclaimable swamp area by states, according to the statistical abstract of the United States, for 1910, issued by the Department of Commerce and Labor:

	Acres.		Acres.
Alabama	1,120,000	New Jersey	601,900
Arkansas	5,760,000	New York	576,000
California	1,850,000	North Carolina...	2,400,000
Connecticut	37,700	North Dakota...	226,000
Delaware	200,000	Ohio	200,000
Florida	18,500,000	Oklahoma	35,000
Georgia	2,400,000	Oregon	500,000
Illinois	2,688,000	Pennsylvania	96,000
Indiana	1,000,000	Rhode Island....	17,900
Iowa	800,000	South Carolina...	1,760,000
Kansas	160,000	South Dakota...	226,000
Kentucky	224,000	Tennessee	800,000
Louisiana	9,600,000	Texas	1,620,000
Maine	240,000	Vermont	70,000
Maryland	356,000	Virginia	384,000
Massachusetts ...	138,000	Washington	75,000
Michigan	4,400,000	West Virginia...	2,500
Minnesota	4,500,000	Wisconsin	2,500,000
Mississippi	6,173,000	Wyoming	25,000
Missouri	1,920,000		
Nebraska	256,000	Total	74,541,700
New Hampshire...	43,000		

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By FREDERICK A. SMITH, C. E., Hydraulic Engineer

This new book is a splendid volume of over 200 pages of absolutely new matter pertaining to the subject of Hydraulics and its allied branches. All the subjects treated of are handled in a simple and practical way to make them of use to the men who have been unable to obtain a college education, but who are successful practical men in fields where they require a knowledge of the principles of Hydraulics and instructions how to solve their problems in a simple and satisfactory way. This book is indispensable for anyone engaged in works relating to Hydraulics, Irrigation or Drainage; it is primarily designed for the practical man in the field, but will be equally welcome to the trained Hydraulic Municipal and Railroad Engineer especially, on account of the many valuable tables compiled by the author, which will save a tremendous amount of time in computations.

Condensed Table of Contents.

Article	I. General Properties of Matter.
Article	II. Algebraic Principles.
Article	III. Geometrical Principles.
Article	IV. Trigonometry.
Article	V. Mensuration of Plane Figures.
Article	VI. Mensuration of Solids.
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Article	XIX. Ditches.
Article	XX. Ditch Tables and Their Applications.
Article	XXI. Flow Measurements.
Article	XXII. The Use of Logarithms.

Tables.

Fourteen tables giving the factor C for all cases of channels for a coefficient of roughness; n varying from .008 to .050, inclusive, for channels having a hydraulic radius from .01 ft. to 900.0 and for slopes varying from 0.1 to .000025, thus practically covering every possible condition.

Tables of square roots of numbers used for r and s .
Table of Hydraulic Elements of the Circle.
Table of Hydraulic Elements of Composite Section.
Table of Areas and Circumferences of Circles.
Table of Hydraulic Equivalents.
Table of Weights of a Cubic Foot of Various Substances.
Conversion Table of United States and Metric Measures and Weights.
Table of Squares, Cubes, Square Roots and Cube Roots.
Table of Logarithms.
Table of Natural Sines and Cosines.
Table of Natural Tangents and Cotangents.
Conversion Table, millions of gallons in 24 hours in other units.

Table of sizes of pipes or cylindrical conduits required for the flow of given quantities of water at given velocities.

Most all of these tables have been originated and computed by the author and have been checked in practical work and found to be correct, so that the tables alone will be worth many times the cost of the book.

The price of the book has been placed as low as is consistent with the superior quality of the work and it may be obtained on the following terms: \$2.50 a single copy, cloth bound; if order is sent with a new subscription to Irrigation Age or a renewal subscription, the book will be sent and the Irrigation Age one year for the sum of \$3.00.

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Reclamation Notes

CALIFORNIA.

E. J. Blossom of Tehama has filed on 200,000 inches of the floodwaters of Cottonwood creek to be taken from the stream at a point fifteen miles west of that city. The water will be stored in a huge reservoir and used to irrigate 15,000 acres of land.

Articles of incorporation have been filed by the Moulton Irrigated Lands Company of Yuba City, with a capital stock of \$500,000 divided into 50,000 shares at \$10 each. The company has extensive holdings in Colusa and Sutter counties.

The directors of the Oakdale Irrigation district have awarded the contract for building 300 miles of laterals and ditches to the Utah Construction Company, work to be completed by March 1st, 1913. The contract is estimated at \$1,250,000. Work will be begun at once on the 7,000-foot tunnel that is necessary to bring the water under a wide range of fields. The Oakdale district embraces 68,000 acres of some of the most fertile land in San Joaquin county. Water for irrigation will be taken from the Stanislaus river, where a diverting dam is now under construction.

Charles Teague of Modesto has purchased 640 acres of unimproved land adjoining the city of Turlock and will sub-divide the land into small tracts. The land is under the Turlock irrigation system.

The Secretary of the Interior has awarded the contract to the Riverside Portland Cement Company of Riverside for the delivery of about 10,000 barrels of Portland cement for use on the Yuma irrigation project. The contract price is \$1.37½ per barrel, f. o. b. cars Riverside.

The Consumnes Irrigation Company is preparing to bring 20,000 acres of land lying near Herald under irrigation.

Fifty thousand dollars have been paid to property holders of the Newville section for options on property for the dam site and lake site for the Newville irrigation project. In addition to this options have been taken on several thousand acres of land along the proposed canal just west of the town of Willows. Capitalists have made and approved plans for one of the largest power plant in California to be run by water from the lake. It is stated that water can be used twice for power generating before it passes into the irrigating canals. L. W. Warmoth of Paskenta, together with other capitalists, is interested in the undertaking.

The United States Reclamation Service has completed 39 per cent of the work of building a siphon under the Colorado river to carry water fourteen miles from the Laguna dam on the Arizona-California border to irrigate 55,000 acres of land in the Yuma valley.

Work is to be commenced in the near future on an immense pipe line system and reservoir for the irrigation of a large body of land recently acquired by a number of prominent ranchers who have incorporated as the Citrus Heights Development Company. The principal office of the company is located at Oxnard. The company intends planting the several hundred acres to lemons. The irrigation system will cost approximately \$5,000.

D. E. Lane of Sacramento, manager of the Doyle Townsite Company, is preparing to construct an irrigation system that will furnish water to a large tract of land near Doyle. The preliminary work is now being done and it is expected that construction work will be commenced early in the spring.

Fifty thousand acres of Tulare Lake lands, lying near Alpaugh, are being placed under irrigation. This tract of land is known as the Homeland Colony and is located in Kings county. L. L. Brandenburg of Pasadena, who is heavily interested in this section, is constructing twenty miles of canals which will carry water over the project.

The Hallwood Irrigation Company of Marysville have commenced work on an irrigation system which will water the Hallwood tract and Stahl holdings north of that city. The estimated cost of the project is \$10,000.

To turn a dry lake into an immense reservoir and the subsequent irrigation of thousands of acres of fertile land, is a plan disclosed here recently when C. H. Walton, Albert Grant and W. P. McArthur of Los Angeles filed with the county recorder appropriation notices which claim 3,000 inches of the surface flow and 50,000 inches of the subsurface flow of the Mojave river, to be diverted through a 20-foot ditch at a point near Otis on the Salt Lake Railroad. The appropriators plan to impound the water in a dry lake bed and by this means bring 3,000 acres of rich land under irrigation and cultivation.

COLORADO.

Farmers in the vicinity of Romeo are making extensive preparations for the organization of an irrigation district for financing the building of the Mogote reservoir, six miles southwest of that town. The district will embrace 20,000 acres of land and 18,000 acres have been pledged.

A number of ranchmen in the vicinity of Clifton and Palisade will protest to Congress against the action of the Reclamation Service, which refused to allow them damages for injury to their lands because of the construction of the High Line canal, for the reason that they were homesteaders.

Denver capitalists have formed the Tyrone Construction & Irrigation Company to reclaim 25,000 acres of land near Tyrone, Colo. The land is segregated under the Carey Act. The project involves an expenditure of \$1,000,000. Work on the construction of canals, which are to carry water from the Purgatoire and Apishapa rivers, has already been started. Land will be ready for settlement by the summer of 1912. The officers of the company are Frank C. Dinsmore, president; Samuel H. Alexander, vice-president, and C. Lorimer Colburn is the engineer for the new project.

At a meeting of the Palisade Protective Association and the reclamation officials held at Palisade recently, the ranchmen voted unanimously to give right of way to the canal on the route favored by the government. The land owners have been demanding that their land not be touched, as it would involve a heavy loss to their orchards. The project as planned by the government will irrigate about 53,000 acres of land in Mesa county. Water will be taken from the Grand river for irrigation purposes.

The Mountain Supply Ditch Company of Fort Collins has been consolidated with the North Poudre Irrigation Company. The new company will be capitalized at \$1,200,000 and will irrigate 40,000 acres of land. There will be 10,000 shares. Each share will be entitled to 200,000 cubic feet of water. The Mountain Supply Ditch Company, now owners to one-fourth of the North Poudre, have valuable water-rights from the Michigan river and other mountain streams. The North Poudre has a valuable irrigating system, but is lacking in water supply.

The Cedar Ridge Irrigation Company of Grand Junction has let the contract for an immense reservoir, to cost \$40,000. The company plans to irrigate several thousand acres of land lying near Fruita.

The North Fort Morgan Reservoir Company, comprised of Denver capitalists, has completed a system which will irrigate 6,400 acres of table land four miles north of Fort Morgan. The project involved an expenditure of \$100,000 and the enterprise was financed without the aid of irrigation bonds or eastern capital, its stockholders

having subscribed the necessary \$100,000 and paid for the work as it progressed. The water supply is secured from Wild Cat creek. Among those interested are George T. Prince, S. W. Widney, Walter P. Miller, Walter G. Christie, Dr. James Arneill, H. S. Classon and E. S. May, all of Denver.

Articles of incorporation of the Pueblo Irrigated Farms Company have been filed with the secretary of state. Capital stock is \$500,000. Principal offices of the company are located in Pueblo. The objects of the company are to buy, sell and acquire farm lands in Pueblo, Huerfano and Otero countries.

Assistant U. S. District Attorney Ward has made final proof before the state land referee at Montrose of the federal government's water priorities under the Gunnison tunnel project. These rights date back to 1901. This action marks the completion of one of the greatest tunnel projects in the United States. Three hundred canals and ditches carry water to every section of the 175,000 acres of land under the Uncompahgre valley. The government has already spent \$4,700,000 on the system and it is estimated that it will require \$1,000,000 more to complete the system. The last tract of government land in the valley will be opened for settlers the coming spring.

IDAHO.

Between 8,000 and 9,000 acres of land were filed upon at Jerome recently as the result of the opening of a 14,000 acre tract under the Carey Act on the North Side Twin Falls tract, to be irrigated by what has been designated as the first pumping system of the Kuhn interests in Idaho. The Kuhn interests in Chicago are represented by H. L. Hollister & Company, Home Insurance building.

Work on the Portneuf-Marsh irrigation project in Bannock county is being rapidly pushed to completion and water will be delivered in time for irrigation this season. There are 20,000 acres of land in the project. The reservoir dam and other head works are completed and the reservoir is being rapidly filled with water. The Kidder-Peabody syndicate of Boston, Mass., are financing the project.

The United States government has constructed a railroad twenty-one miles in length extending from Boise to Arrow Rock. The road was built to carry laborers and supplies for work during the next four or five years on what is to be the highest dam in the world, the Arrow Rock dam, which will be 350 feet high. The flood and excess waters of the Boise river, which the dam will hold back, will be used in irrigating 250,000 acres of land on the government irrigation project near Boise.

The Munsey Ditch Company has filed articles of incorporation, with principal office at Arco. The capital stock is \$13,600, divided into \$100 shares. Water will be taken from the Big Lost river to supply irrigation for land in Blaine county.

The Black Canyon Irrigation district has voted a bond issue of several million dollars to finance the construction of an irrigation project to claim 100,000 acres of land lying in western Idaho, bordering on the Snake river. Construction work on the project will be begun immediately. The proposed plans for the storage of water to irrigate the large area call for the construction of a big dam on the main Payette river, three miles north of Horseshoe bend, at a cost of several thousand dollars.

Articles of incorporation have been filed by the Raft River Reclamation Project Company. The purpose of the company is to reclaim lands in Cassia county. Principal offices are at Boise. The company has a capital stock of \$1,000,000. Water will be taken from the Raft river to irrigate 60,000 acres of land embraced in the project.

Settlers on the Kings Hill irrigation project, located in southern Idaho, surrounding Kings Hill, have asked the State Land Board to declare the contract that the state has with the Kings Hill Irrigation & Power Com-

pany forfeited. The water users further refuse to negotiate with the Farwell Trust Company or its successors, the Woodland Company, of Chicago. The Kings Hill project embraces 18,000 acres of land in the Snake River valley. Several years ago the state entered into a contract with the Kings Hill Irrigation & Power Company for the construction of an irrigation project by which the land could be watered. The lands were opened under the Carey Act and subsequently settled upon. When the project was about half completed it was discovered that the construction company did not have enough money to complete the project. New capital was interested and eventually \$1,500,000 was expended, but the project is not yet completed. The settlers complain that they have not enough water to irrigate their lands and ask the state land board for a remedy.

UTAH.

The Grande Valley Fruit & Water Company of Denver, Colo., is planning to place 5,000 acres of land under irrigation this spring. The land lies in the eastern part of the state of Utah and is tributary to Denver's markets. The company propose to secure about 70,000 acres additional from the government under the Carey Act and will ultimately reclaim about 81,000 acres. The water supply will be taken from the Grande river. The enterprise contemplates an expenditure of about \$250,000.

The Strawberry tunnel, which the Reclamation Service is building through the Wasatch mountains in order to bring waters from Strawberry valley to irrigate lands near Utah lake, is now 65 per cent complete.

WASHINGTON.

The residents of the Kittitas reclamation district have voted five million dollars in special improvement bonds to build an irrigating canal of water 91,000 acres of land. The land lies near the city of Ellensburg. Construction work will be begun by July of this year.

The Yelm Irrigation Company, which was organized nearly a year ago, have surveyors in the field now to map out the route for the proposed Yelm irrigation ditch. Yelm prairie and other prairie lands lying near the town of Yelm will be embraced in the project which comprises some 10,000 acres. The ditch is to tap the Nisqually river some distance southeast of Yelm and carry the waters to the prairies for distribution. The estimated cost of the project is \$125,000.

OREGON.

The Warner Lake Irrigation Company of Portland has filed maps and plats with the government land office at Lakeview, and applications for additional sites and water supply whereby 150,000 acres of land in Warner valley may be reclaimed. Water will be taken from Honey and Deep creeks. It is the intention of the company to generate power from Deep creek as well as from Honey creek and use the waters for generating power and irrigating the lands. In addition to three reservoirs, the company will use hydro-electric power pumping plants on Flagstaff lake and drain its waters upon the lands, thereby reclaiming many thousands of acres of land now submerged by several feet of water. The total cost of the enterprise is estimated at \$3,000,000.

Articles of incorporation have been filed with the secretary of state by the Vale-Oregon Irrigation Company, with a capital stock of \$1,000,000. The principal office of the company is at Vale.

The Goose Lake Irrigation Company's project, lying twelve miles from Lakeview, is rapidly approaching completion. The company has expended about \$1,000,000 to handle the waters that come from Drews, Thomas, Cottonwood and other creeks into the lake, by building a large dam at the mouth of the canyon, thus forming a natural reservoir.

MISCELLANEOUS.

A permit has been granted by the state engineer of South Dakota to W. O. Hulchins of Lindsay, Stanley

county, to appropriate water from the Cheyenne river for the irrigation of 32.81 acres of land.

The Frenchman Valley Irrigation Company has been organized in several western Nebraska counties for the purpose of taking over much of the stock and holdings of the old Culbertson Ditch Company. There are 10,000 acres of land irrigated under the system at present.

The secretary of the interior is asking for bids for the construction of an earth dam and auxiliary works on the North Platte irrigation project, about six miles north of Minatare, Neb. The work involves the handling of about 840,000 cubic yards of material, of which 630,000 cubic yards is earth fill, 157,000 cubic yards gravelly material, 14,000 cubic yards unscreened gravel, 11,500 cubic yards screened gravel, 14,000 cubic yards concrete and 12,000 cubic yards brute clay excavation, besides 45 acres of sod stripping, 600 feet of wells and casing, 3,200 linear feet of drains and the handling and placing of 250,000 pounds of reinforcing steel. The proposals will be opened at the office of the United States Reclamation Service, Mitchell, Neb., on February 28, 1912. The purpose of this dam is to create one of a series of reservoirs on the main interstate canal. The water impounded by this dam will be used to irrigate 30,000 acres of land at the lower end of the North Platte project.

The Alamo Land & Sugar Company of Ebenezer, Texas, is planning to irrigate 35,800 acres of land adjoining the city of Ebenezer. The company will construct an irrigation system and the land will be subdivided into forty-acre tracts. Water supply will be obtained from the Rio Grande river.

Articles of incorporation have been filed by the American Overhead Electrified Irrigation Company with a capital stock of \$200,000. The principal office of the company is located at 20 Broad street, New York City.

The North Platte Irrigation Company of Douglas, Wyo., has completed a large irrigation pumping plant on the Platte river near Glenrock, and will begin construction work on ditches in which the pumps will pour 40,000 gallons of water per minute after raising it 40 feet. The ditches will irrigate more than 30,000 acres of bench land.

A. J. Clippy and A. B. Hamilton, both of Los Angeles, Cal., together with other capitalists, are planning the reclamation of an immense tract of land near the city of Cibola, Yuma county, Arizona. The main canal of the system will be seventeen miles in length with one hundred miles of ditches. Water will be taken from the Colorado river for irrigation purposes. It is stated that it will take two years to complete the project.

P. J. Conway of Sweetwater, Nev., and Geo. P. Costigan of Sonoma, Nev., together with other Reno capitalists, have formed the Walker River Power Company, to reclaim 50,000 acres of land in Mason valley. This land has been segregated under the Carey act, and construction work on the project will be begun early in the spring.

W. G. Kleine, of Cleveland, Ohio, has purchased 120,000 acres of land situated in Upton, Crane and Crockett counties, and will install a system of sub-irrigation of the land, and colonize it with farmers from the middle states. Laterals will be placed under the ground and the water is permitted to seep through the ground by openings in the concrete tubes every few feet. The laterals on the Kleine farms will be fed from deep water wells.

The state engineer of South Dakota has granted a permit to Louis LaPlant of Elwood, Stanley county, to appropriate water from the Cheyenne river to irrigate 423 acres of land.

H. M. Half of Midland, Texas, has purchased 12 sections of land near that city for a consideration of \$90,000. Irrigating wells will be installed immediately and special attention will be given to the raising of alfalfa.

A receiver has been appointed for the Columbia River Orchard Company of Seattle, Wash., which is bonded for \$5,000,000, the Washington Orchard & Irrigation Company and other companies subsidiary to the first.

The Empire Trust Company of New York has filed for record in the deed of trust records of Medina county, Texas, a deed of trust from the Medina Irrigation Company on all of its holdings, rights and benefits in the county, valued at \$6,000,000, as security for \$6,000,000 five per cent, thirty-year first mortgage bonds, issued by the irrigation company.

State Engineer Miller, of New Mexico, has approved the application of Furman & Burke of Denver, Colo., for 750 second feet of the Las Animas river, to reclaim 80,000 acres of land in San Juan county on the Colorado boundary.

Plans have been drawn and approved for the construction of a fifteen-foot dam across the Colorado river a few miles below Austin, and for the installation of a hydro-electric plant for the purpose of irrigating several thousand acres of valley land and furnishing power for operating the machinery of farmers of that section. D. B. Matthews, Chas. Jones and Goodwin Jones, of Austin, are interested in the enterprise, which will cost about \$50,000.

The foundation of the Strawberry Valley dam, a structure that is being built across the Strawberry river near Provo, is completed. J. L. Lytle, superintendent in charge of the project, states that the government will have the work completed by the end of 1913.

The contract for the construction of eight miles more of the Piute reclamation project canal has been awarded by the state land board to the Western Construction Company on a bid of \$21,337. The canal is to be extended from its present terminus, just west of Redmond in Sevier county, to a point eight miles north of that place, to furnish water to about 2,000 acres of land in that section.

The La Sal Irrigation Company, with offices at Moab, has filed articles of incorporation with the Secretary of State, to engage in a general irrigation business. The capital stock of \$8,000 is divided into shares of \$10 each.

TEXAS.

The Medina Irrigation Company of San Antonio has let the contract for the construction of 28 miles of canal in Medina county, including flumes, dams, siphons and culverts, to Roach & Stansell of Memphis, Tenn. The contract calls for work to be completed by July, 1913.

Chile is producing great harvests of cotton and other valuable staples by extended irrigation. Already about 2,500,000 acres of her territory are being treated in this way and about as much more of her land is available for the same purpose.

Several million dollars are being spent this year alone on the Payette-Boise project. A dam has already been built nine miles east of Boise, Idaho, in the Boise river, canals have been dug and preparations made for engineering accomplishments which will result in irrigating and reclaiming 169,000 acres of land which are now arid and untillable. Engineers have been at work on the project for the last three years and it will take two more years to complete it.

Good books are like good friends; they are always ready to be consulted and they always give good advice.

See that your shelves are lined with such books, and above all see that you get THE IRRIGATION AGE regularly.

CHANGE OF ADDRESS.

Jas. A. Green & Co., Inc., engineers and contractors, announce the removal of their Chicago offices, from 226 South La Salle street to 111 West Monroe street.

Supreme Court Decisions

Irrigation Cases

STATE ENGINEER—

The state engineer has no power or authority to interfere with vested rights, or to grant a permit for the appropriation and diversion of water, where the same has already been appropriated and applied to a beneficial use.—*Youngs v. Regan*, Supreme Court of Idaho, 118 Pacific 499.

PERMANENT STREAM—

Where through a natural obstruction part of the water of a stream was diverted and flowed in a given manner for a time longer than that fixed by the statute of limitations, the water diverted was a permanent stream.—*Pacific Live Stock Co. v. Davis*, Supreme Court of Oregon, 119 Pacific 147.

WATER APPURTENANT TO LAND—

A division of a tract of land to which a water right is appurtenant by the sale of a portion thereof, without segregating or reserving the water right, works a division of the water right in proportion as the land is divided by the conveyance.—*Russell v. Irish*, Supreme Court of Idaho, 118 Pacific 501.

RIPARIAN RIGHTS—

The canal of an irrigation company which has condemned all the waters of a stream should be treated the same as the stream, as affecting the question whether land of a purchaser from the company on the line of the canal is riparian land.—*McKenzie v. Beason*, Court of Civil Appeals of Texas, 140 Southwestern 246.

QUALIFICATIONS OF VOTERS IN IRRIGATION DISTRICT—

Section 2 of the act of March 6, 1911 (Sess. Laws 1911, p. 461), wherein it is provided that a holder of land within the district who is a resident of the state is a qualified voter at an election held in the irrigation district, violates the provisions of section 2, art. 6 of the Constitution.—*Pioneer Irr. District v. Walker*, Supreme Court of Idaho, 119 Pacific 304.

QUALIFICATIONS OF VOTERS IN IRRIGATION DISTRICTS—

Section 2 of said act of March 6, 1911 (Laws 1911, p. 461), also violates the provisions of section 1, art. 6, Const., in that it provides that each voter may vote and have his ballot marked according to acreage of land owned by him, and according to the number of inches of water used by him within the district.—*Pioneer Irr. Dist. v. Walker*, Supreme Court of Idaho, 119 Pacific 304.

SURFACE WATER PRIVATE PROPERTY—

The Constitution (section 3, art 15) confers and protects the right to "divert and appropriate the unappropriated waters of any natural stream to beneficial uses," but does not purport to deal with private waters, such as private ponds, artificial lakes, or wells owned by private persons and formed by collecting and impounding surface water.—*King v. Chamberlin*, Supreme Court of Idaho, 118 Pacific 1099.

CLASSIFICATION OF CONSUMERS—

Any classification made by an irrigation company under the provisions of section 3287 of the Revised Codes can in no way affect or control the question of priorities between users, and in no way prohibits or limits any user of water in having the question of priority between users settled and adjudicated in the proper court of the state.—*Brose v. Directors of Nampa & Meridian Irr. Dist.*, Supreme Court of Idaho, 118 Pacific 504.

PRIORITY OF APPROPRIATION—

The amount of water that may be taken by a prior appropriator for irrigation depends on the number of acres of irrigable land susceptible of cultivation, the degree of sterility of the premises, the most profitable crops that can be raised by artificial application of moisture, and the quantity of water necessary to produce the harvest by careful husbandry.—*Donnelly v. Cuhna*, Supreme Court of Oregon, 119 Pacific 331.

IRRIGATION DISTRICTS—

The irrigation act of 1897 (St. 1897, p. 254), authorizing the creation of irrigation districts, is not unconstitutional, because section 1 authorizes a majority of the holders of title of lands, according to the equalized county assessment roll for the year last preceding, to propose organization, on

the theory that the apparent owners by the assessment roll may not be the present owners, since the legislature could provide for the formation of districts without giving property owners any voice.—*In re Bonds of South San Joaquin Irr. Dist.*, Supreme Court of California, 119 Pacific 198.

WATER COURSE—

A gulch through which water flows from about March 1st until August, being derived from melting snows and springs, constitutes a "water course," waters of which are subject to appropriation, *Borman v. Blackmon*, Supreme Court of Oregon, 118 Pacific 848.

RIPARIAN RIGHTS—

Where a water right is subsequent and inferior to another's riparian right, the latter may use all the water required for domestic purposes and for proper irrigation of the land riparian to the stream. *Driskill v. Rebbe*, Supreme Court of South Dakota, 133 Northwestern 246.

WATERS APPROPRIABLE—

Under L. O. L. Section 6673, providing that ditches constructed to use waste, spring, or seepage waters shall be governed by the same laws relating to priority of right as ditches constructed to use waters of running streams, waters flowing through a gulch, and derived from melting snows and springs, are subject to appropriation. *Borman v. Blackmon*, Supreme Court of Oregon, 118 Pacific 848.

CLASSIFICATION OF CONSUMERS—

If a mistake is made by an irrigation company in making the classification as required by the statute, and a consumer is placed in the wrong classification, he can have such classification corrected in the courts, and he is not compelled to accept the classification made by the ditch company. *Brose v. Directors of Nampa & Meridian Irrigation District*, Supreme Court of Idaho, 118 Pacific 504.

WATER COMMISSIONER—

Comp. St. 1910, Section 801, requires a water commissioner, when he regulates a headgate in accordance with adjudged priorities to attach thereto a written notice stating that such headgate has been properly regulated and is wholly under his control, which notice is made legal notice to all parties interested in the distribution of the water of such ditch. *Held*, that the notice was not objectionable as a taking of property without due process of law in that no hearing of the owner is provided for. *Hamp v. State*, Supreme Court of Wyoming, 118 Pacific 653.

IRRIGATION ACT VALID—

Irrigation Act 1897 (St. 1897, pp. 276, 277), Sections 68-72, providing for proceedings to test the validity of irrigation district assessments, is not invalid, under Const. art. 4, sec. 24, as being foreign to the title of the act, "An act to provide for the organization and government of irrigation districts and to provide for the acquisition or construction thereby of works for the irrigation of lands embraced within such districts, and also to provide for the distribution of water for irrigation purposes." *In re Bonds of South San Joaquin Irrigation District*, Supreme Court of California, 119 Pacific 198.

BOARD OF CONTROL—

As an incident to its power to adjudicate priorities, the board of control must determine whether one claiming an appropriation for irrigation has sufficient interest in the ditch to be used for conveying the water, and, while its determination may not conclude a subsequent judicial determination of interest or ownership, the water commissioner may act upon such determination of interest in distributing water upon the certificate of appropriation, in the absence of any other lawful determination as to ditch rights or of a record showing the ownership of each interested party made pursuant to Laws 1907, c. 86, secs. 22-27, and Comp. St. 1910, secs. 808-812. *Hamp v. State*, Supreme Court of Wyoming, 118 Pacific 653.

WATER CONTRACT—

A contract, in terms granting "all the water now flowing or hereafter to flow" from three certain wells on a certain five acres, and covenanting that the water flowing from the wells at the date of the contract measures more than 110,000 gallons a day, and that, if the water flowing therefrom shall decrease to less than 105,000 gallons a day, the grantor will, "from the water rising or flowing from or on said five acres, or that can be developed from said five acres," increase the flow to 110,000 gallons a day, but that he shall not be obliged to furnish more than one-third of all the water that may be flowing on or from said five acres, or that can be developed or obtained therefrom, is not a contract to furnish 110,000

gallons of water a day, or a specific quantity, but is a grant of all the water flowing from the three wells, with an agreement to endeavor to keep that flow up to 110,000 gallons by certain means, and to the extent of one-third of the water obtained by such means. *Jones v. Van Nuys*, Supreme Court of California, 118 Pacific 541.

CONDEMNATION OF LAND FOR DAM SITE—

In a proceeding to condemn land for a dam site in connection with an irrigation project, opinions of expert engineers as to the value of the land, taking into consideration the cost of the land to be utilized, the cost of construction and maintenance of the works, the feasibility of utilizing the water, the prospective amount available, the lands available for irrigation, their value, the value of the water furnished, etc., were admissible under the rule that in determining the value of land to be condemned it must be viewed, not merely with reference to the uses to which it is at the time applied, but with reference also to such uses to which it is manifestly adapted, considering its capability as well as its availability, disregarding, however, its value for any specific purpose as an independent fact. *Weiser Valley Land & Water Co. v. Ryan*, U. S. Circuit Court of Appeals, 190 Federal 417.

JURISDICTION TO RESTRAIN FLOODING—

Where a water company has constructed a dam across a stream for the purpose of impounding water, and the dam or structure results in the flooding of the lands of another, and an action for condemnation of such land is thereafter prosecuted in the federal court, and a judgment is entered in favor of the landowner for the value of the land taken, and the company thereupon appeals to the United States Circuit Court of Appeals, the state court has the jurisdiction to issue an injunction to restrain such company from flooding and submerging the land sought to be condemned until such time as the value thereof has been paid to the landowner, or into court for his use and benefit, as provided by law. In such case, there is no conflict of jurisdiction between the state and the federal courts, and no rule of law or comity requires the state court to desist or refrain from taking jurisdiction for the purpose of protecting the landowner in his ownership and right of possession. *Ryan v. Weiser Valley Land & Water Co.*, Supreme Court of Idaho, 118 Pacific 769.

MEANS FOR DEVELOPING WATER—

A contract, granting all the water flowing from three artesian wells on a certain five acres, with the right to conduct it, at the expense of the grantees, from the wells by pipes inserted into the wells between two and three feet below the surface of the ground, and providing that, if the wells fail to supply 110,000 gallons a day, the grantor will, "from the water rising or flowing from or upon said five acres, or that can be developed or obtained from said five acres, immediately at his own expense" increase the stream of water for the grantees to a flow of 110,000 gallons a day, but that the grantor shall not be obliged to furnish the grantee more than a third of all the water that "may be flowing on or from said five acres, or that can be developed from or obtained by putting down as many wells as can be safely made * * * to a depth of from 20 to 50 feet, at least one-half of said wells to be 50 feet deep"; and that, if after sinking them sufficient water shall not be developed to furnish the grantees with 110,000 gallons, they may demand that the wells shall be so deepened as to obtain such supply for them, they to bear a third of the expense thereof; and nowhere mentioning the employment of artificial means to furnish the grantees water from the wells to be sunk or deepened, or the expense of any such thing—does not contemplate that the grantor shall install a pumping plant, if sufficient water cannot be developed without it, though with it enough can be developed. *Jones v. Van Nuys*, Supreme Court of California, 118 Pacific 541.

EFFECT OF APPROPRIATION OF WATER RIGHT—

Whenever a water right, as defined by the Constitution, is acquired under the provisions of Rev. Codes, § 3292, the owner of the tract of land where the water is applied, his heirs or assigns, shall forever be entitled to the use of the water necessary to properly irrigate the same, by complying with such reasonable regulations as may be agreed upon or as may from time to time be imposed by law; and the payment for such water right shall be a release of any bond or mortgage upon the property of the company from whom such water right is acquired, or their successors or assigns, to the amount of the water right purchased and paid for; and it is the duty of the company from whom the water right is

purchased to furnish the purchaser or his assigns, a release from said mortgage, so far as the same affects said water right. By the transfer provided by the statute, the water right became attached to the particular tract of land upon which it is used. *Hewitt v. Great Western Sugar Co.*, Supreme Court of Idaho, 118 Pacific 296.

IRRIGATION DISTRICTS—

Sess. Laws 1909, p. 319, § 4, relating to the duties of the Board of Control, consisting of two division superintendents and the state engineer, provides that the division superintendent shall have control over the water masters of the several districts within his division, and may make regulations for fair distribution of water in accordance with the "determined rights" as may be needed. Section 11 provides that on petition to the Board of Control by water users, requesting determination of the relative rights, the board may "make a determination" of the rights, fixing a time for the taking of testimony, etc. Section 24 provides that, after compilation of said data and the filing of the evidence, the board shall cause to be entered of record an order "determining and establishing" the several rights. Section 27 makes it the duty of the circuit court to transmit a copy of the decree to the secretary of the Board of Control. Section 37 gives to the water master authority to regulate distribution of water among various users, "where rights have been determined, in accordance with existing decrees." Held, that the references to "determined rights" were only to such as were determined pursuant to said act, and the Board of Control did not have jurisdiction to supervise the distribution of irrigation water taken from a stream before the rights and priorities of the parties had been determined under said act, and the water master was not entitled to compensation for acting in such unauthorized distribution. *Wattles v. Baker County*, Supreme Court of Oregon, 117 Pacific 417.

HOMESTEADS.

When an entryman had made a former homestead entry of less than 160 acres for which he acquired title, he was not qualified to make an entry under the reclamation act.

The act of March 2, 1889 (25 Stat. 854) has no application to entries under the reclamation act, and the additional right granted in said act of March 2, 1889, cannot be exercised by entry within a reclamation project. Citing instructions, June 16, 1909. (38 L. D. 58.)

When a claimant made entry for a technical quarter-section of land, and after five years' residence thereon obtained title thereto, he exhausted his right.

The fact that the land patented lacked a little more than two acres of making 160 acres did not give him the status of a qualified homestead entryman or the right to enter under the enlarged homestead act, an additional 320 acres.

Extenuating circumstances in favor of entryman will not justify the department charged with the duty of disposing of the public lands in the manner provided by law, to dispose of them contrary to the express provisions of that law.

A homestead entry must be canceled as a mere pretext of residence and improvement where it is shown that the entryman merely made occasional visits to the land, where he merely had a house furnished with stove and dishes, it being shown that the entryman was in partnership in a threshing machine and other farm machinery.

IRRIGATION BONDS—

Where an irrigation district has proceeded in conformity with the statute to issue irrigation district bonds, and has procured an adjudication and confirmation of the proceedings in conformity with the statute and of the assessment of benefits against the several tracts of land within the district, the same becomes res adjudicata against both the landowners and the district in all subsequent proceedings, in so far as the same may involve the assessment of benefits against the several tracts of land.—*Russell v. Irish*, Supreme Court of Idaho, 118 Pacific 501.

SURFACE WATER PRIVATE PROPERTY—

Where K. builds dams and dikes on his own land and collects surface water from the rains and melting snow and forms a lake on his own lands, which is in no way fed from any natural stream or regular flow of water, held, that the water so accumulated and impounded is the private property of the owner of the land and is not subject to appropriation or diversion by any other person without the consent of the landowner, and that the state engineer has no right or authority to grant a permit to any other person to appropriate or divert such private waters.—*King v. Chamberlin*, Supreme Court of Idaho, 118 Pacific 1099.

CORRESPONDENCE

GROWING CORN UNDER IRRIGATION.

Editor IRRIGATION AGE:

I am not only going to tell you how to grow corn, but I want to show you I can produce the goods.

I have been asked to give my results in growing corn and preparing the land under irrigation. It is a long-used expression, "You must like the work or you will not succeed."

My first experience in growing corn was in Pennsylvania, and a short time after in Nebraska, where I grew 20 bushels of corn to the acre, and it only received one light shower from the time it was planted—the last of May—until it was harvested in October. My neighbors asked me how I did it. I told them the best I could. I was only about 19 at that time. I sold that corn that year at 50 cents a bushel.

When I came to Idaho more than 25 years ago I asked about growing corn. "Yes, we raise a little sweet corn here, and some few have tried field corn, but we have such a peculiar climate here—the nights are so cold in summer that corn suckers very badly, so we do not grow it, and we raise wheat on the land to raise more wheat to buy more land to raise more wheat."

Some of the old bottom land, at this time, would not grow wheat. I bought 80 acres of this land, and they told me the crops that had been growing there for several years were sunflowers.

I plowed this land the latter part of May, about eight inches deep. Some time in June I went over it with a harrow. In July I cultivated it to get out every sunflower I could see.

During that winter we completed an irrigating ditch that had been started two years before.

During this time I had been watching for a patch of corn around the neighborhood that I could get some seed from to plant. I wanted seed that was acclimated. I finally succeeded in getting a bushel.

In March the following year we turned the water into the ditch. A week later the ditch broke one night and flooded over a part of this land that I was going to plant to corn. As soon as it got dry enough to work, I plowed this with the rest of the tract, about eight acres. I then took an "A" harrow, turned it upside down and put a plank across it, and rode the harrow. Why did I do that? I was going to irrigate this tract of land to raise corn on, and it had never been leveled. While it did not require much leveling, still there were a few bumps on the land, and I was aiming to settle this ground down as well as to settle the newly plowed land.

I reversed the harrow and went over the ground twice, standing on the harrow the last time.

About the middle of April I went over to one of my neighbors and borrowed an old Acme harrow, and went over the ground three or four times until it looked more like an onion field than a corn field, and as it was on the side of a main traveled road I could hear all kinds of remarks about that piece of ground.

Five days after planting that corn it was up, and I noticed the ground that had been flooded was so moist and worked so fine that when it was time to irrigate I desired not to irrigate this part, but the part of the field that I thought required the moisture.

Shortly after this irrigating I noticed the corn throwing out suckers, while the other side that flooded and was not irrigated did not throw out suckers. I was interested, and I did some hard thinking as well as work the next five years experimenting with corn.

Some of you will say that is the way we grew corn in Washington in the early days, but here in Idaho we are 3,000 feet higher, and our soil is different. Let us see what Idaho soil and sunshine did last year for me:

We moved over from Washington and located one mile south and one mile east of Nampa. We arrived at night, and the next morning I went down Main street and saw some very good looking corn in the window of a real

estate office. I went inside and asked the gentleman if I could examine the corn. "Well," he thought, "here is a corn sucker sure enough," and I had to shut him off by saying that the corn had stood shipping remarkably well. That corn was raised here, but he could not tell me by whom, or where I could get some seed.

On the place we moved to there was a five-acre tract called pasture. There was a little bluegrass sod to be seen in small spots, but the most I saw was weeds about four inches long. It had been tramped to death by the stock because the little stable was so filthy that the stock had to be turned out in that lot.

This tract of land should have been plowed in the fall, or early winter, but it was not.

In April I started to plow, using two horses to a common turning plow or stubble plow. The horses weighed 1,140 pounds, and the plow was a 12-inch walking plow.

I had some experience preparing ground for corn, but this was the most discouraging that I ever undertook until the plants were up and looking fine.

The ground was rather dry—no water available, for it was not turned into the ditches. I wanted to plow about six inches deep, but it was so tramped and so hard that I could not do it. It ran all the way from two inches to 10 inches. Part of the time I was walking, and part of the time I was riding the handles of the plow. The team was walking rather slow and very steady, but I tell you I was not. I plowed about an acre a day, and hitched on to the harrow every half acre I plowed.

The day I finished up my nearest neighbor came over, and told me he thought it best for me to sow oats or barley. I told him I wanted corn, as it was the cow feed I was after, and if I could get it wet up a little bit later I would try and plant any time in May.

I had a four-horse Cutaway disk. A neighbor allowed me the use of his team a little later, as I only had the two horses to put on the four-horse disk, and there was not horsepower enough to do a good job.

Three days after disking I floated the ground down with a leveler. This leveler consisted of two pieces 2x6x16 feet by 5 feet wide, and constructed in such a way as to be perfectly rigid.

Three days more went by, and it began to look like rain, and I hitched two horses on the four-horse disk and disked the ground the same way I plowed.

I had been making inquiries as to where I could get seed. Here is where the business men of the town can help out the farmer. In this case he was a lumber dealer, but was as enthusiastic over the possibility of growing corn in Idaho as I was, and he said he knew men who could put me in touch with someone who had seed that was acclimated, and he did so.

On the 20th of April water came, and Saturday evening I ran some furrows, and was going to float this ground over Monday. Saturday night it rained, and Sunday afternoon it rained a heavy shower, doing a better job of irrigating than I could. It was four days before I could disk this piece of ground. I floated it down again after disking, and let it lay two days.

I used what is known as "100-day Yellow Dent corn," purchased from the John A. Saltzer Seed Company, and was supposed to have been grown in South Dakota under irrigation. I decided to plant this corn three feet each way.

As the weather was nice, I harrowed it over with a common harrow, then disked it again, and floated it down ready to irrigate, but it rained again that night.

The 16th of May I harrowed it over, and made the soil fine and the 19th and 20th I planted the corn with a hand machine set to plant two to three grains in a hill.

I expected to have this corn up in five days, but there came along a couple of those peculiar cold nights, and it was seven days before it showed up nicely. It did not all come up. There was some adobe spots still a little rough, and I had to plant the corn deeper in these spots than on the other land.

On the 1st of June we had a wet cold spell which lasted several days. The corn turned yellow, and then it got hot, and I put one horse on one section of the harrow, and went down one row and back up the other. It looked like I was just tearing that corn out as fast as I

could with that horse, but I wanted to hold the moisture as well as to break up that crust on the adobe spots.

All the corn came up, and after it was all up and looking fine there was 85 per cent of a perfect stand, but still I didn't know just how I was going to irrigate that corn.

On the 8th of June I started my one-horse cultivator—a common, ordinary five-tooth cultivator—going.

On the 13th of June I crossed the field with a two-horse hitch on the same harrow that I had been using one section of, having added the other section to it. I had one of the boys follow on behind, and rake off the soil on what corn had been covered up too deep.

I kept the cultivator going over it about every five or seven days, for it was growing an inch a day in Idaho, and the weeds I killed when doing that cultivating.

On the 1st of July it had not yet been irrigated. I ran water in some of the furrows, and as soon as it got through I moved the water over to the other rows. Some of these rows that had received a little more water than the others, when it got down to the far end, by planting this corn in checks, I could handle it both ways, for there were a few rows not wet enough.

Ten days later that five-acre plat of corn was the talk of the neighborhood. Where the plat had formerly been raising weeds, here was corn like that raised in Iowa.

When it had been planted 60 days the average height over the entire five-acre tract was 60 inches.

The last of July and August I gave this corn all the water it would take, and kept on cultivating.

On the 13th of August I shut the water off because the corn was ready to mature up.

In September the leaves had begun to turn that yellow color, indicating maturity, and also the ears had begun to turn yellow, and some ears were very well matured even to their very tips.

The average height of this corn was 9 and 10 feet, and some few stalks were 12 feet. It was very even all over the tract, even these adobe spots producing excellent corn.

As a result, three acres of this corn filled a silo 10

feet in diameter and 30 feet high, according to the silo estimate, holding 45 tons of ensilage, or in other words, there was enough ensilage to feed 10 dairy cows almost eight months.

The remainder of the corn I shucked, which averaged me 60 bushels to the acre.

I kept track of the cost of growing that corn, and found it ran \$7.50 per acre, counting 60 cents an acre for water. It cost 75 cents a ton to cut this corn up and put it in the silo, not counting our own labor we had on the farm. Counting our own labor at the same wages we paid other help, cost \$1.25 per ton to put this corn into the silo after it was grown.

I had some worms in that corn. If the land had been plowed in the fall there would have been practically no worms, because the larvæ eggs would have been turned up and exposed to the winter weather, and a large part of them killed.

J. L. STINSON.

Note.—The above interesting shorthand notes were taken by Frank S. Reid, Wendell, Idaho, at the State Dairy Association meeting held in Twin Falls, Idaho, January 3d and 4th, 1912.

PROPOSES NEW LAWS FOR IRRIGATION DISTRICTS.

Lamar, Colo., January 30, 1912.

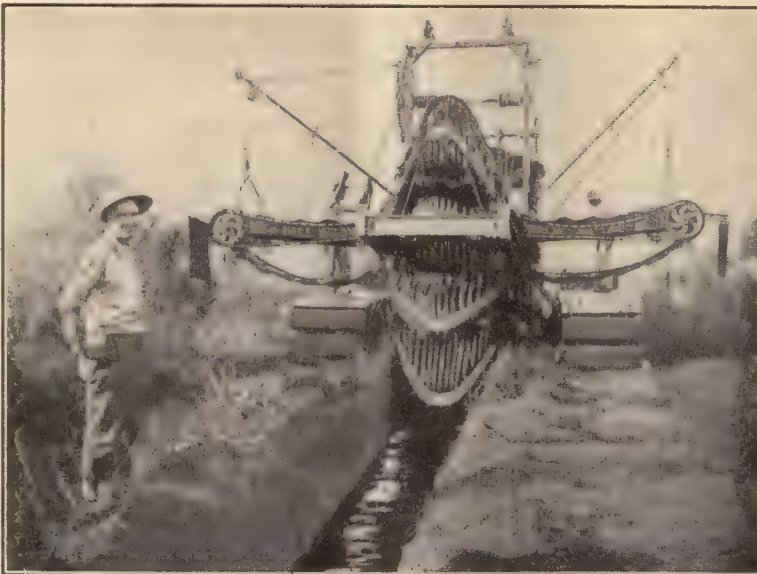
Editor IRRIGATION AGE, Chicago, Ill.

Dear Sir: Having some land in the southeastern part of Colorado that is in a proposed irrigation district, the directors of which have met with much difficulty to dispose of the bonds of the district before beginning construction work, on account, I presume, of seeming inadequate security, therefore I take the liberty of addressing you and suggest an irrigation and drainage law that would expedite all irrigation or drainage enterprises. As you are aware, all such projects are handicapped under the present law and are subject to delay and excessive costs.

Could not a law be passed by Congress simplifying the procedure and lessening the cost of construction and assuring to the owner of irrigable or wet land a minimum cost of any proposed irrigation or drainage works and

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WHEREVER used the **Buckeye Open Traction Ditcher** has proven a big factor in reclaiming waste and marshy land for colonization purposes and in irrigation projects throughout the South and West. With the aid of a **Buckeye** land that was considered useless has been rendered more valuable than the natural land adjoining, because of its fertility.



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and will dig ditches of from 2½ to 12 feet top and cut any slope desired. It will dig a ditch with a sloping bank at a continuous cut.

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than a gang of men. Every ditch is of uniform size and perfect to grade. Smaller ditches can be dug with a large machine by purchasing an extra set of buckets, backs and friction wheels.

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The Buckeye Traction Ditcher Co.
FINDLAY, OHIO

also, at the same time, give the state in which such irrigation or drainage works are situated full control of such land, as is done under the Carey Act and also make land that has been filed on, but on which final proof has not been made liable for the costs per acre, equal with deeded land?

The same also could be made applicable to land that requires draining and would eliminate the possibility of grafters and financial pirates getting control of land under any proposed irrigation or drainage works and give to investors a safe form of investing funds and would also prevent the operation of any fraudulent or "wild cat" schemes, that is now possible under the present system.

I have had the following scheme in my mind for some time and have been prompted to write you, after reading in the Chicago papers some time ago, that the Secretary of the Interior contemplated making some new rulings regarding public land. The system I would propose to be followed would be, to form irrigation or drainage districts; as under the present law. After the formation of any such districts and a petition signed by the majority of the land holders or entrymen in any such districts and directed to the state engineer, who shall, upon presentation of any such petition, make or cause to be made by himself or the engineer or engineers of the county or counties in which such irrigation or drainage works are situated, an immediate survey of said districts and shall, upon the completion of such survey of any such irrigation or drainage works, report to the secretary of state the costs of the survey and estimate of the costs of construction of any such contemplated irrigation or drainage works; whereupon the secretary of state shall authorize and empower the directors of any such contemplated irrigation or drainage districts to issue bonds to be collected as other taxes are collected and signed by the president of such irrigation or drainage districts and countersigned by the treasurer of the state in which such districts are situated. Said bonds to be redeemed by the state treasurer or the treasurer of the county or counties in which such irrigation or drainage works are situated.

Yours very truly,

C. M. DARLING.

THANK YOU, MR. CONDREN.

Laredo, Texas, February 3, 1912.

Mr. D. H. Anderson,
Chicago, Ill.

Dear Sir:—I am a reader of your paper, THE IRRIGATION AGE, and find it very interesting reading. I look for it like I do for my daily paper. In your paper I read a letter from a Mr. Boyce on South America and am very much interested in that country and have written him a letter and enclosed it with this one. I wish you would see that he gets it.

If there is, at any time, anything that I can do for you in this country don't hesitate to ask me, as it would be a pleasure to serve you. Thanking you in advance, I am

Very truly yours,

A. J. CONDREN,
Laredo, Texas.



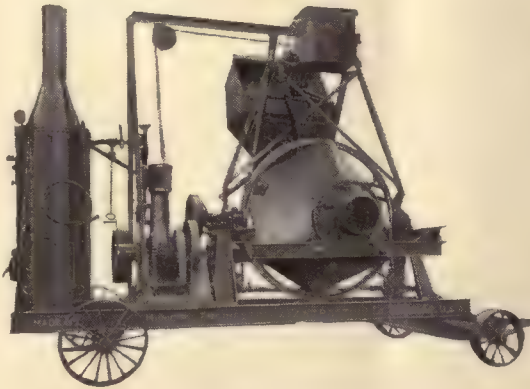
Illustration of Badge Used at First National Irrigation Congress Held at Deming, New Mexico, 1893.

Secretary of the Interior Fisher has vetoed the scheme which the Pacific Reclamation Company, with offices in Salt Lake City, was promoting. This company applied for the segregation of 25,000 acres of land under the Carey Act, but investigation showed that they had water sufficient for only 10,000 acres. The application was cut down to meet the water supply, but the company proceeded to try to sell 25,000 acres with inadequate water supply. Secretary Fisher thereupon threatened to deny the company any lands under the Carey Act and this probably will put an end to the scheme.

Noah Allen of Brownsville, Texas, is promoting the organization of an irrigation system to embrace 50,000 acres, and proposes to construct a dam across Nueces river about seven miles from Cotulla, to be about 75 to 100 feet high and about 300 feet long.

Chicago Improved Cube Mixer Used on a Dam Across Rock River at Milan, Ill.

This is what the contractors, the Gould Construction Co., Davenport, Iowa, had to say about it:—



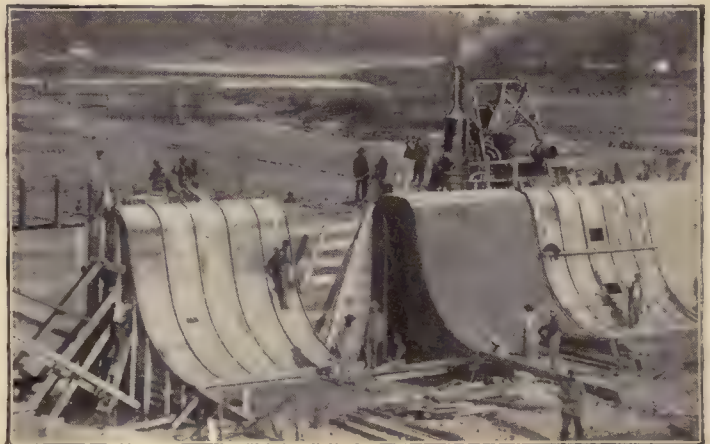
The Chicago Improved Cube is charged in batch units and the batch never chokes, because there are no inside shelves or vanes to dam back its free flow.

It discharges by tilting, just as one in a hurry would empty a bucket, by tipping it bottom up, not bailing it out with a cup.

It mixes the most uniform concrete that can be mixed, because: (1) It mixes by kneading as a cement tester mixes cement paste for test briquettes. (2) Every mixing motion acts on the whole batch and is definite and invariable in action and periodicity.

"Chicago Improved Cube Mixer No. 11, holding 11 cu. ft. of mixed material, was placed on the false work of dam, 23 ft. from the ground, with elevator extended to the ground level, where the cement, sand and gravel were deposited directly into the charging hopper, which in turn delivered the material directly into the mixer, and from the mixer it was delivered to the forms.

"The work consisted of 31 sections, each 15 ft. long, and was completed in 31 days. The arrangement for placing the mixer was very satisfactory, and we were not delayed for one moment for any cause as far as the mixer was concerned, and we have mixed as high as 80 batches per hour."



Front view, showing section of finished dam at Milan, Ill.

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Western Pennsylvania Agent—J. S. Beckwith, 108 Parkway, N. S., Pittsburgh

San Francisco Agent—The Lansing Co., 789 Folsom Street

Options on land near Devine, Texas, have been taken by J. Miller, representative of a stock company that has been formed in the North for the purpose of irrigating a large tract of land in that section. The company, it is stated, is capitalized at \$4,000,000. It is their intention to purchase between 25,000 and 30,000 acres of land and sink several wells that flow into a reservoir, which, with the aid of three dams, will impound many million gallons of water.

Private capital will irrigate an 18,000-acre tract of land near Plainview, Texas, and subdivide it into forty-acre farms. The names of the promoters have not yet been made public.



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Look for Trade Mark on Sole

IRRIGATION STATISTICS OF SOUTH DAKOTA.

The total acreage irrigated in 1909 was 63,248 acres, against 43,676 acres in 1899, an increase of 19,572 acres, or 44.8 per cent. During the same period the improved area on farms increased 40.2 per cent, showing a very slight increase in the per cent of improved land irrigated—from 0.39 per cent in 1899 to 0.40 per cent in 1909.

The total acreage which all enterprises were capable of irrigating in 1910 was 128,481 acres, an excess of 65,233 over the area irrigated in 1909, showing that the present irrigated acreage can be doubled without the construction of new works. The acreage included in projects now completed or under construction is 201,685 acres, an excess of 138,437 acres over the area irrigated in 1909. This indicates in a general way the acreage which will be available for settlement within the next few years.

The number of independent enterprises reported in 1909 was 395, against 188 in 1899, an increase of 207, or 110.1 per cent. This per cent is much higher than the per cent of increase in the acreage irrigated, indicating that the newer enterprises are smaller than the older ones. Many of the new ones are reservoirs and artesian wells irrigating single farms. The length of main ditches in 1909 was 631 miles, against 223 miles in 1899, an increase of 183 per cent. This high percentage indicates again the decreased size of enterprises. The number of reservoirs reported is 314. Most of these are small, irrigating single farms, or small parts of single farms.

The total cost of irrigation systems as reported for 1910 was \$3,043,186, against \$270,018 in 1899, an increase of \$2,773,168, or 1,027 per cent. The average cost per acre

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give higher efficiency than any other system of pumping water by water power—60 to 90%.



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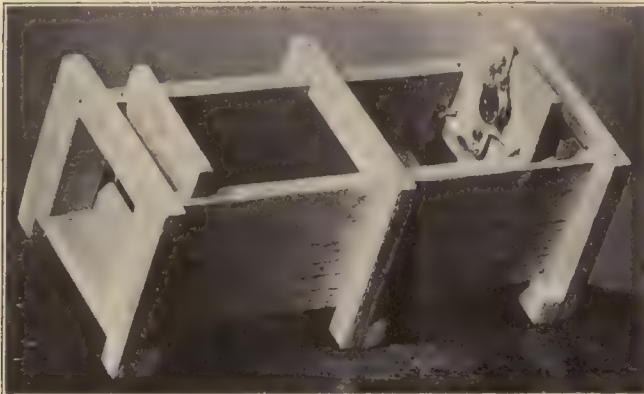
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Combination Headgate and Measuring Device.

The belief that Capital and Labor, that Employer and Employee, that Manufacturer and Consumer, that Home Office and Agent, that the House and the Salesman on the road should get together and stay together in a closer and more intelligent manner than ever before, and that all "Big Business" of the future should mean "Big Business" for all concerned, and not merely for the company itself, was the principle upon which this company was founded; and a summary of the results achieved in its short existence up to the present will show how well founded was that belief.

Loyalty to employer is a phrase familiar to all; but loyalty to the employee, while not so much in vogue, is just as essential to rapid progress along substantial lines.



On August 6th, 1911, the IRRIGATORS SUPPLY CO. was granted, by the great commonwealth of Montana, a charter with a capital stock of \$10,000. Loyalty to its agents and employees made it imperative to increase that capital stock to \$50,000, which was done on October 3d. And today, January 1st, 1912, we are arranging for a subsidiary company in the state of Washington, to take care of our business in that state. In two short months this same "loyalty to agents" has given us, in the state of Montana, four Agency Directors, as good traveling salesmen as ever slung a grip. They are A1, high-class gentlemen, prosperous and happy; and, through their untiring work and honest and intelligent manner of presenting our proposition, we now have thirty agents, selected from Montana's best business men, who, in turn, are preaching a uniform and equitable system of measuring water by the use of our COMBINATION HEADGATE AND MEASURING DEVICE.

At times we have felt inclined to the belief that the demand for the device itself was the cause of our rapid growth; but, with any other system or method than loyalty to the employee, we could not have covered the territory with such a sales force in so short a time, no matter what the demand or what the article we had to sell. So we are going to continue our plan with this as our slogan, "Loyalty to the Employee," and make each man a part of the great machine for selling our COMBINATION HEADGATE AND MEASURING DEVICE.

Although our device is approved by the best authorities of the state; although it has the endorsement of U. S. Senators and U. S. Surveyors, general judges and engineers; even though the judges of the courts recommend it, and some even require its use; and though it has the praise of our 800 Montana farmers who are using it, we find loyalty to the employee the most important factor in distribution yet discovered and recommend it to all employers, whether of one man or one million men.

If you are interested in, or troubled about, the measurement of water; or if this subject is causing trouble in your district, and you wish to be instrumental in abolishing the trouble, write, wire or 'phone the

U. S. Irrigators' Supply Co.

Montana Block, Missoula, Montana

in 1910 was \$23.69, as compared with \$6.18 in 1899, an increase of \$17.51, or 283.3 per cent.

The average annual cost per acre of operation and maintenance in 1909 was 64 cents, against 23 cents in 1899, an increase of 178.3 per cent, showing that the newer works are not only more costly in construction, but more expensive to operate and maintain.

The acreage irrigated in 1909 has been classified according to the state and federal laws under which the works were built or are being operated, as follows: United States Reclamation Service (act of Congress, June 17, 1902), 5,613 acres, or 8.9 per cent of the total; United States Indian Service (various acts of Congress), 50 acres, or 0.1 per cent; cooperative enterprises, 13,601 acres, or 21.5 per cent; enterprises supplying water for hire, 6,300 acres, or 10 per cent; independent and partnership enterprises, 37,684 acres, or 59.6 per cent. No land was irrigated by Carey Act enterprises or irrigation districts. Under the act of June 17, 1902, the works built by the United States Reclamation Service are to be turned over to the water users. Including these, 90 per cent of the land irrigated is served by works controlled by the water users.

Streams supply 47,662 acres, or 75.4 per cent of the total area irrigated; lakes supply 200 acres, or 0.3 per cent; wells supply 1,456 acres, or 2.3 per cent; springs supply 395 acres, or 0.6 per cent; and reservoirs supply 13,535 acres, or 21.4 per cent.

The Secretary of the Interior has awarded contract to James W. Jory of Klamath Falls, Oregon, for the construction of Schedule 4A, Lost River diversion channel, on the Klamath irrigation project, Oregon-California. The contract price is approximately \$4,060.

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To sell highest grade irrigated fruit land in the country. Exceptionally attractive selling terms. This is the best paying proposition today for land men who are live wires in all sections of the country. Address ROBERT S. LEMON, General Sales Manager, Bitter Root Valley Irrigation Company, Suite 848-898 First National Bank Building, Chicago.

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MISCELLANEOUS LAND DECISIONS.

DESERT LANDS.

The act of March 28, 1908, granting extension in certain cases, is a remedial law, to be liberally construed and applied so as to relieve and assist entrymen who have acted in good faith in the arduous work of reclaiming desert lands. Citing *Hoobler vs. Treffry* (39 L. D. 557).

A desert land entryman may make proof of reclamation and receive patent within four years from date of entry. In order to obtain extension of time in which to submit final proof under provisions of Section 3, of the Act of March 28, 1908 (35 Stat. 52), it must appear that failure to reclaim was "without fault on his part" and due to "some unavoidable delay in the construction of the irrigating works intended to convey water to the said lands."

Desert land entrymen should not, in general, depend upon co-operation with adjoining land proprietors or entrymen for the necessary water to reclaim land entered.

PRACTICE.

Although the commissioner of the general land office may avail himself of the aid of a contestant in determining the validity or invalidity of a lieu land selection, his refusal to accept such aid is not the denial of a legal right, and his exercise of discretion in such matters will not be controlled by the department unless it is clearly apparent that it has been abused. Applications to contest therefore denied and decision of the commissioner affirmed.

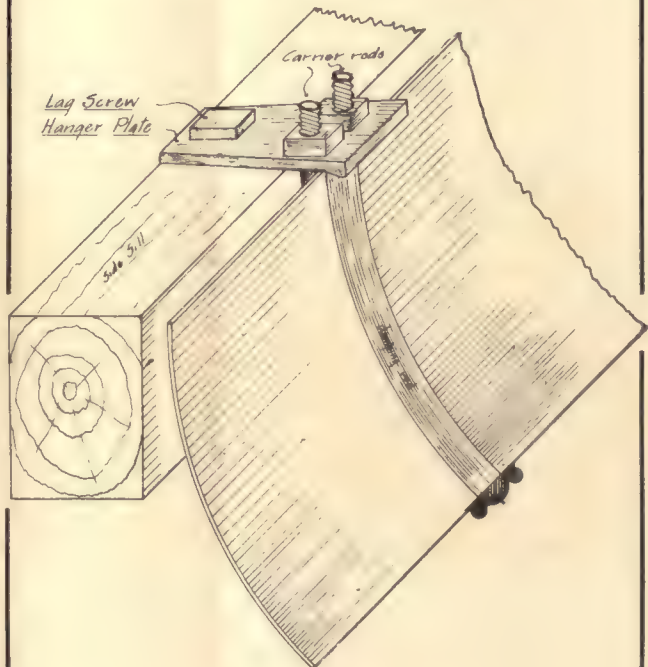
FINAL PROOF.

Where there are conflicting claims in cases of final proof, a hearing before the local office is the only means by which all parties can present the respective claims to the land and therefore such hearing will be ordered by the department in such cases.

The commissioner of the general land office has full jurisdiction to reverse the action of the local officers in matters of final proof. Final proof matters are ex parte cases, and no proceedings as upon appeal are necessary, in order to invest the general land office with full jurisdiction.

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Galvanized iron or steel will last many times longer in the open than when covered by earth or sand, hence the advantage of not having any held at flume joints. Dry sand or earth constantly passing over metal surface will wear the surface more or less rapidly, but when mixed with water the specific gravity of water causes a great portion to be entirely suspended in the water and decreases the wearing weight of the heavier substances, thereby causing practically no corroding process on the metal.

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AND

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This Federation is organized for the promotion and encouragement of the irrigation, reclamation, colonization and development of land within the United States of America. It maintains an office at 1110 First National Bank Building, 38 South Dearborn Street, where there is open to the public, free of charge, maps and publications relating to the lands of the United States. Questions relating to irrigation matters will be answered by the officers of the Federation and information given.

THE OFFICERS OF THE FEDERATION ARE:

EDMUND T. PERKINS, President
HENRY C. WOOD, Vice-President
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Organizations and individuals interested in reclamation are invited to become members. Detailed information concerning initiation fees and dues will be furnished upon application to the secretary. Address

D. H. Anderson, Secretary
30 North Dearborn St.,
Chicago, Ill.

Continued from page 137.
trations. The whole book has 329 pages of reading matter besides a table of contents, by chapters, and a complete alphabetical index.

All the subjects treated are up to date and the statistical



An Irrigated Cotton Field in Lower Rio Grande Valley of Texas.

information is reliable, so that the work must be considered of a high character, full of useful suggestions.

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The Irrigation Age Company,
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NOTES OF INTEREST.

Officials of the interior department are apprehensive that owing to a misunderstanding a large number of homeseekers now flocking to North Yakima are going to be greatly disappointed. Reports recently received indicate that settlers are preparing to form a line in front of the land office in the hope of securing a farm on the recently completed Tieton irrigation project.

The facts briefly are that about fifty farm units of government land will be available for entry in 1912. These farms are forty acres each, and contain from 12 to 40 acres of irrigable land. About thirty-five of these will not be available for general entry until the department has acted upon the cases of persons who claim preference rights, and who under the law may have a right to file within thirty days after notice from the land office. The adjudication of these claims will necessarily require some little time, so that the general public will not be offered an opportunity to file on the remaining units for several months, and perhaps not during the present year.

By the usual public notice the secretary will fix the date and determine the method of disposing of the unentered units. It is probable that some form of drawing will be provided for, giving everybody interested an equal chance.

The secretary of the interior has authorized the director of the reclamation service to execute contract with the American Locomotive Company of New York for furnishing a steam shovel for use at Arrowrock dam, Boise irrigation project, Idaho. The total cost to the United States, including freight, will be \$10,188.63.

The secretary of the interior has authorized the reclamation service to enter into contract with Hayes Bros. & John W. Peters, of Janesville, Wis., for the purchase of a line of railroad from

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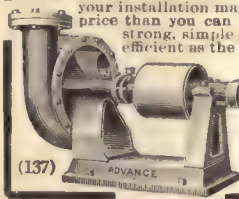
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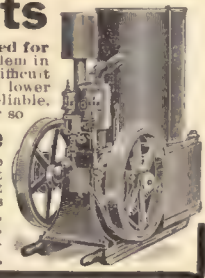
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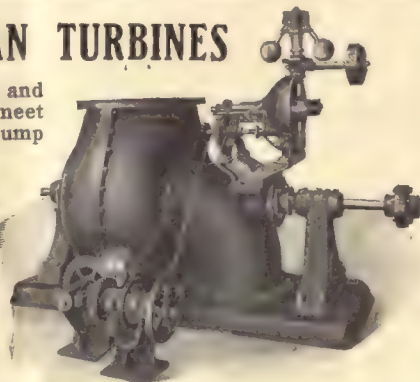
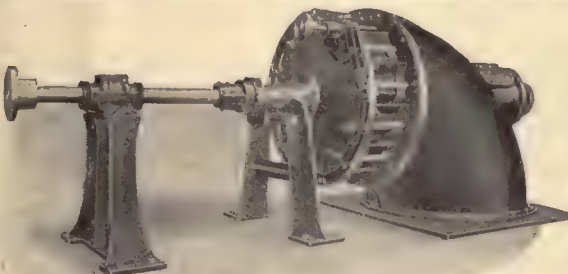
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The settlers on the Huntley irrigation project, Montana, who planted their lands to sugar beets this season are reaping a rich harvest. In the first distribution of funds from the Billings sugar factory which took place on November 15, \$200,000 were paid to the Huntley farmers. It is estimated that the total value of the crop will reach a quarter of a million dollars.

Thirty-six hundred acres out of the total of 12,000 which were put in crop on this project this year were planted to sugar beets, and on many of the farms the yield averaged twenty tons per acre.

According to the reports from the sugar factory some of the finest beets they handled this year came from the Huntley project, although this was only the second crop on that land. There are seven dumps at various points on the railroad so that none of the farmers have a long haul. The heavy lands, which were at first avoided by settlers, are proving the most desirable for the culture of beets. There are still more than thirty of these units unentered. The total number of farms awaiting entry is eighty-eight.

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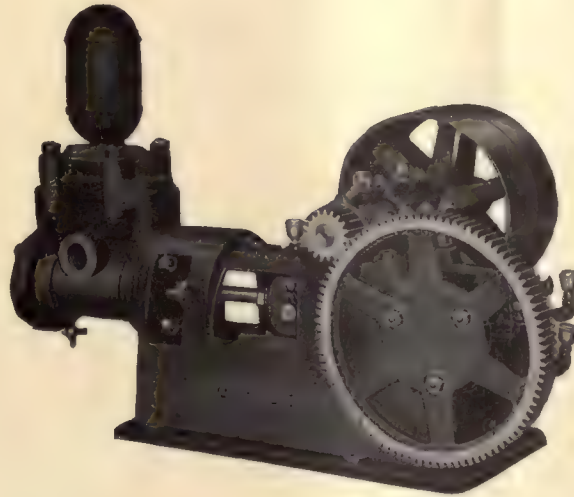
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ands of gallons of water every day. The valve seats are brass, and the valves are accessible without disturbing the pipe connections. They are made in a variety of sizes.

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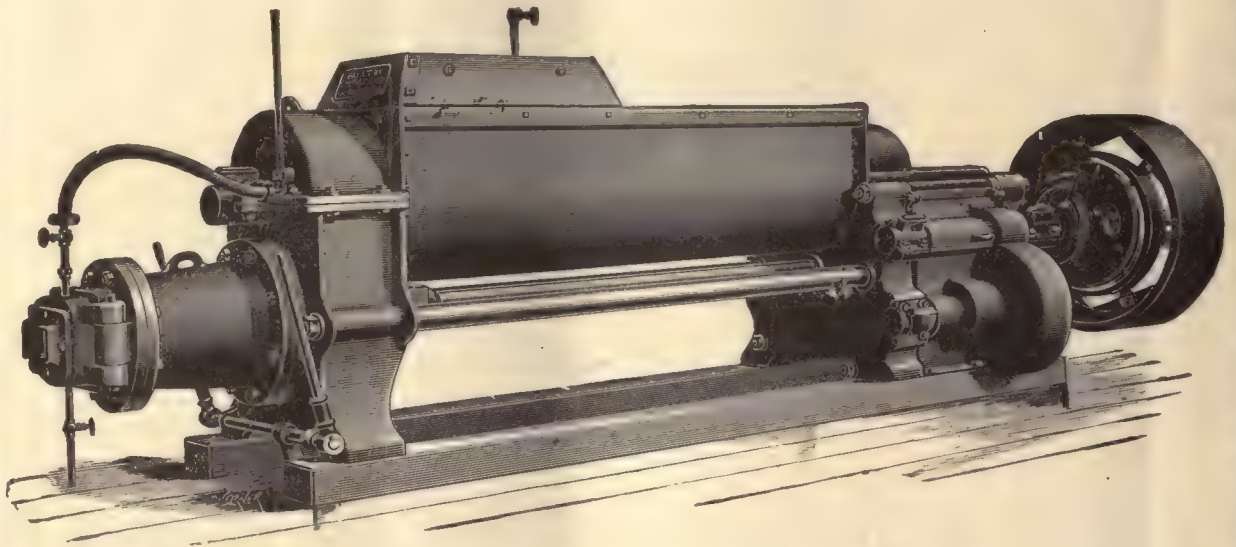
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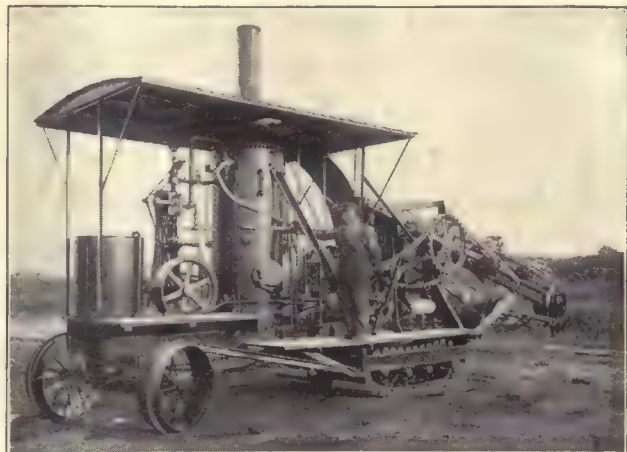
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When open ditches are finished and trenches are to be dug the wheel is removed, a digging boom put on, and the machine is used as shown in lower cut. The positively selfcleaning buckets make fast work possible in sticky soil. The entire outfit is mounted on caterpillar traction which will not mire. You cannot mire nor can you clog an Austin Trenching Machine, and it is equally efficient in hard soil because of its strength and its rooter plow point buckets.

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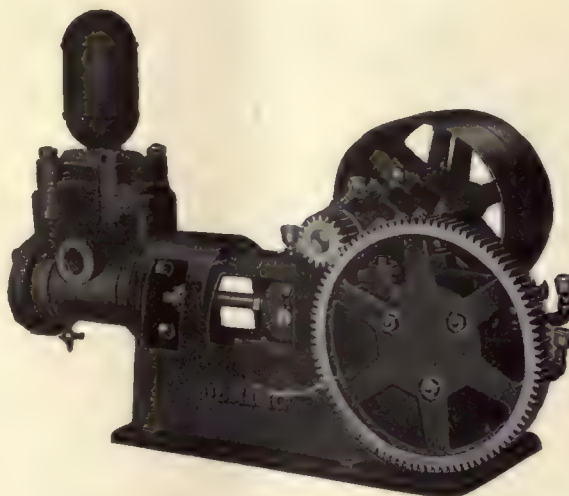
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RAILWAY EXCHANGE, CHICAGO

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When you want to irrigate a plot that is too small for a big centrifugal pump and too big for a small hand pump, you will find that this double-acting outfit is the happy medium—just what you need.

It can be belted to any gasoline engine and will deliver thous-

ands of gallons of water every day. The valve seats are brass, and the valves are accessible without disturbing the pipe connections. They are made in a variety of sizes.

Tell us what you want the pump to do, and we'll arrange the matter to your entire satisfaction.

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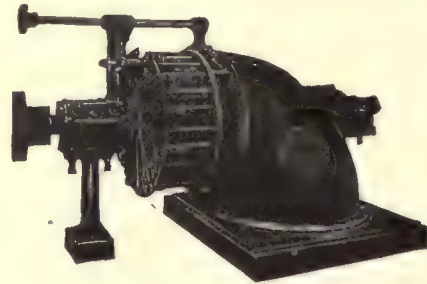
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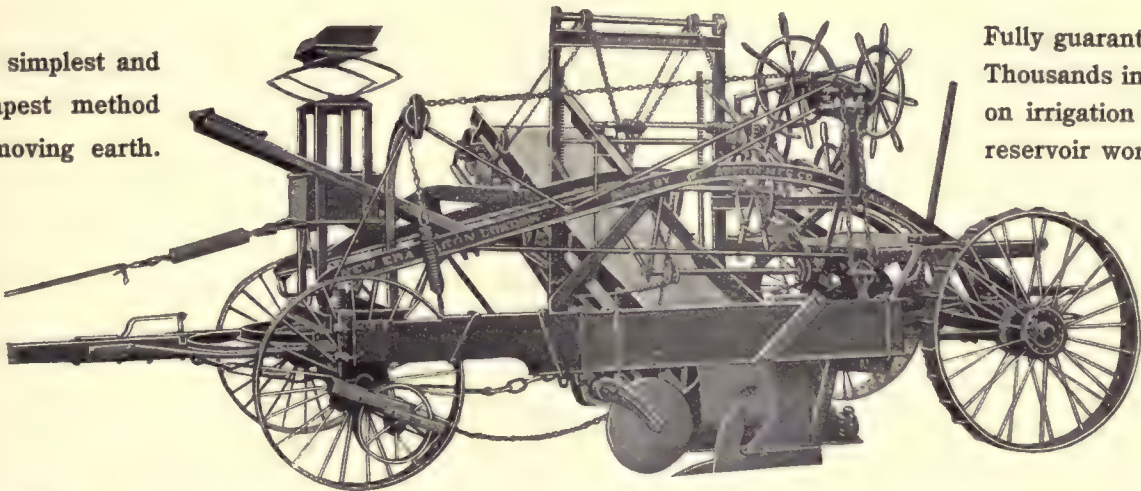
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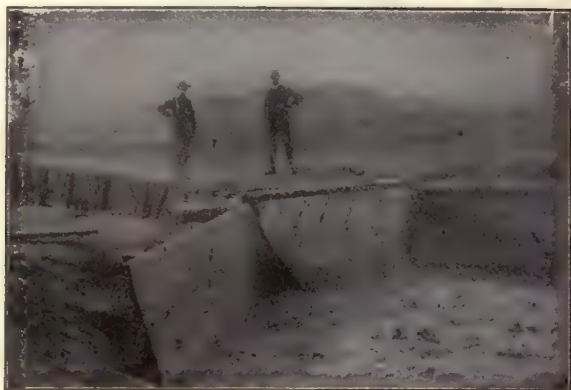
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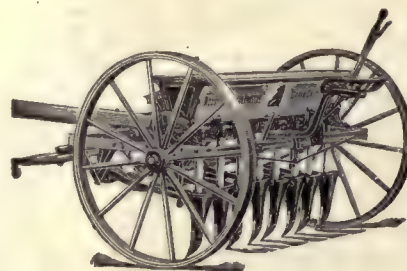
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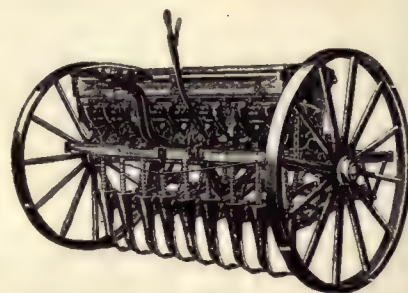
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RICHMOND, IND., U. S. A.

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Styles and
Sizes.

Grass Seed
Attachments
May Be
Added.



IRRIGATION IN Northeastern Colorado

The farmers in this district are irrigating their lands by the pumping system, power for running the pumps being supplied by electric companies who have their power lines well distributed over the country. The cost is nominal. By this system the water supply can be positively controlled and crops are assured. This district is served by the

UNION PACIFIC

STANDARD ROAD OF THE WEST
PROTECTED BY ELECTRIC BLOCK SIGNALS

Our folder, Farming in Northeastern Colorado, telling of the work and possibilities in this district, will be sent on request.



GERRIT FORT,
Passenger Traffic Manager,
OMAHA, NEBRASKA

Twenty-seventh Year

THE IRRIGATION AGE

VOL. XXVII

CHICAGO, MARCH, 1912.

No. 5

THE IRRIGATION AGE

With which is Merged

MODERN IRRIGATION
THE IRRIGATION ERA
ARID AMERICA

THE DRAINAGE JOURNAL
MID-WEST
THE FARM HERALD

D. H. ANDERSON
PUBLISHER,

30 No. Dearborn Street, - - CHICAGO
Old No. 112 Dearborn St.

Entered as second-class matter October 3, 1897, at the
Postoffice at Chicago, Ill., under Act of March 3, 1879.

D. H. ANDERSON, Editor

ANNOUNCEMENT.

The "Primer of Hydraulics" is now ready; Price \$2.50.
If ordered in connection with subscription \$2.00.

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Official organ Federation of Tree Growing Clubs of
America. D. H. Anderson, Secretary.

Official organ of the American Irrigation Federation.
Office of the Secretary, 212 Boyce Building, Chicago.

Interesting to Advertisers.

It may interest advertisers to know that The Irrigation Age is the
only publication in the world having an actual paid in advance
circulation among individual irrigators and large irrigation corpo-
rations. It is read regularly by all interested in this subject and has
readers in all parts of the world. The Irrigation Age is 27 years
old and is the pioneer publication of its class in the world.

The importance of an efficient General
Parcel Post System is self evident, and
the establishment of such a system cannot
be too highly recommended, therefore it
is necessary that the people at large should
make some well organized efforts to the
end that Congress will feel impelled to pass a satisfactory
law which will make the establishment of a U. S. Parcel
Post possible in the very near future.

There are undoubtedly organized forces at work en-
deavoring to defeat legislation in this direction, as the es-
tablishment of parcel posts would mean the end of ex-
ploitation of the people by the express companies who have
grown rich by the exercise of functions which should belong
to the federal government. It stands to reason that these
corporations will not let such a good thing slip away from
them without opposition, and there is nothing more natural
than that they should try to prevent either legislation en-
tirely, or if this is not possible to bring influence to bear
that the resulting Parcel Post will interfere with the Express
Companies but very little. That such efforts are being made
now is evident from the fact that the House Committee on
Post Offices and Post Roads is apparently trying to quiet
Parcel Post agitation by adding riders that are half-way
measures, to the annual post office appropriation bill. They
propose to carry parcels for 12 cents per pound, the same
as now charged to foreign countries, and 50 per cent more
than was charged in 1874. They propose to charge 25 cents
for 11 pounds on the rural routes, or twice what it should be.
Finally they propose an expensive commission of congress-

men, which is ordered to report on the desirability and feasibility of a Parcel Post in 1914. But we don't want a Parcel Post in 1914, we want it now, and the quicker Congress realizes, that the people, and especially the farmers are in dead earnest in their desire for the establishment of a Parcel Post the quicker will their wish be complied with.

The essential thing at this time is concerted action by all interested, and we feel sure that 99 per cent of our readers desire a Parcel Post operated for the benefit of all the people and desire it without undue delay. It must be admitted further that there are a number of disinterested men who are devoting their time and energies to the advancement of the cause of the people in this direction, and foremost of them is the Honorable W. A. Henry, Emeritus Professor of Agriculture of the University of Wisconsin. He is sparing neither labor nor expense to rouse the rank and file of the farmers and others concerned to action in the matter. Here is an extract from one of his communications which should bring results:

"Recently I spent some time in Washington attending hearings on Parcel Post held by the Senate Committee on Post Offices and Post Roads, Jonathan Bourne, Chairman. I soon found that powerful interests, well organized, were opposing a General Parcel Post system by every possible means, especially by flooding Congress with petitions in opposition and by urging one cent letter postage. Do you want from the present Congress a General Parcel Post system such as all other civilized people enjoy? Then at once spend 6 cents in saying so by letters to your two senators and your representative.

"Do not expect congressmen to vote for a Parcel Post when they are all the time hearing from the opposition and not a word from you. Petitions are the lazy man's way of discharging the duties of citizenship. Write three letters now and get your neighbors to write. Be sure to oppose one cent letter postage.

"On FARMER'S PARCEL POST LETTER DAY, March 18, 1912, join with the other farmers all over the land in again writing letters to your congressman. Ask for a General Parcel Post and not one limited to rural routes. Only by co-operation and timely effort can the friends of Parcel Post win their cause."

This is addressed to the farmers of the United States, showing the tremendous importance of the matter and the necessity of prompt action.

Many of the readers of the IRRIGATION AGE will not receive this issue until after March 18, 1912, but don't let that deter you from writing the three letters as Mr. Henry suggests. A steady stream of letters demanding a satisfactory Parcel Post system for the United States, will result in the desired end when once the law makers in Washington are made to see that their constituents are in earnest. This will be fighting the opposition with its own weapon, as it is easy to estimate that for every letter sent to Congress opposing the Parcel Post there can readily be forwarded a hundred letters demanding Parcel Post legislation satisfactory to the people.

It should be remembered that but a short time ago the establishment of Postal Savings Banks was fought bitterly by the money interests, but when Congress saw that the people were in earnest, the enabling legislation was passed, and though the resulting measure contains objectional features, it is an entering wedge which has made it possible for the Government to provide an absolutely safe place for people to deposit their savings.

While it is true that legislation bearing upon this subject should be thorough, and as near perfect as possible, it must be remembered that too radical changes may effect adversely the prosperity of the country. Thus, to pass a law which would put the express companies entirely out of

business immediately, could not be considered a wise plan. But it seems that a law extending the Postal Service to packages weighing up to 15 pounds should be passed, regulating the charges according to distance carried, so that for instance a package of 15 pounds or less should be forwarded at a rate of 2 cents per pound to any point on the same rural route; for greater distances the Zone System should be used under a carefully considered tariff rate.

Ninety-nine per cent of the citizens of the United States want a Parcel Post, and want it right away.

Spring Is Here Now.

The month of March is the herald of approaching spring for the Northern Hemisphere of which the United States is a component part, and therefore its advent is usually hailed with delight as the harbinger of vernal condition and pleasures.

On the 22d of this month the sun crosses the equator on its way back from the South to do duty in the North; this day makes day and night equal all over the world and the sun stands perpendicular over the equator, so that at noon objects standing upright throw no shadows along this line. On this date the sun shines the last time on the newly found South Pole and for the first time on the North Pole; after this the South Pole is left in darkness for six months, while the North Pole begins its long day lasting till the 22d of September.

These phenomena are ultimately connected with the changes of seasons, which are really caused by the relative position of the sun, which swings like a pendulum from one hemisphere to the other, bringing spring and summer to the one and fall and winter to the other. As most of our readers are located on the Northern Hemisphere, we are looking forward with them to an early breaking up of wintry conditions to make room for the many and varied activities which follow the advent of spring.

It would be a useless and impossible task to try to enumerate all the necessary jobs which the early spring requires of the irrigator in particular, and the farmer in general; for each particular case has its own particular problems, and the work of the irrigator in Montana is widely different from that of his fellow craftsman in California. Yet certain principles are of general application and we will touch upon one of them for a moment.

One of the most important things for success along any line must be considered close attention to business requirements; this is just as important on the farm as in the shop or store; this includes a good knowledge of the technic of a business as well as the actual performance of all the tasks which such business requires; thus it is not only necessary for the farmer to know that repeated cultivation of his land enhances its productive value, but he must actually do the work and in order to do this satisfactorily it is essential that all the required tools are in good working order.

Right here is a point where millions of dollars are wasted annually by the American farmers for the reason that they do not take better care of their tools and machinery. The careful up-to-date farmer has a place for every tool, from the axe and hoe up to the reaper and threshing machine; not only has he a place for every tool but every one of them is in its place, and has been properly taken care of so that during the winter season they do not corrode or rot. Then when spring knocks, all that is necessary is to take the needed tools down and look them over and make them ready for work. If tools and machinery are thus taken care of

they will last for seasons and pay a heavy annual dividend on the capital invested. There is, however, too much carelessness practiced in this respect. Some farmers consider themselves too poor to build a shed to shelter their wagons and farm implements, and as a consequence they are left outdoor exposed to the wind and weather with the result that after one year's use the machinery is in bad shape and after two or three more years is utterly worthless, necessitating a large outlay for new machinery. As a matter of fact a set of farm implements, when properly cared for and intelligently used, should last with reasonable repairs fifteen to twenty years.

The irrigator in addition to the farm tools, has his irrigation appliances to look after and they should care for them to keep them up to their best efficiency. Ditches should be cleaned out and reshaped and sediment should be removed from flumes; gates should be operated and repaired whenever necessary, and in fact everything used by him during the growing season should be placed in readiness for the approaching spring and summer. Then with good tools and careful and continuous work he may reasonably expect when harvest time arrives to participate in a good share of an abundant crop, which is much more of a certainty to him than to the average farmer for the reason that he does not need to worry about the rain, as he can turn on the water whenever his fields or crop require it.

**Regulation
Does Not
Mean
Extermination.**

Much has been said on the subject of legislation relating to trusts without reaching any desirable or definite results. The Sherman anti-trust law as now upon the statute book is evidently in need of revision, for the reason that it provides for the destruction of business rather than for proper regulation. There is no doubt in the mind of any reasonable citizen of the United States as to the necessity of supervision of large business concerns in which there is no competition to provide against unreasonable exploitation of the public. This very thing has been done for many years by our government through the Interstate Commerce Commission in everything pertaining to the various railway systems. It is true, when the Interstate Commerce Commission was first organized there developed bitter opposition by the railway corporations against such government interference with business, but after some years of experience the wisdom of that arrangement has been proven, as it protects the corporations and citizens alike, preventing on the one hand exorbitant rates for freight and passenger business, and on the other hand guards against injury to the business of the common carriers by unreasonable legislation in the various states; thus, what at first sight seemed to be a threatening innovation, has proven a blessing, and there is today no intelligent citizen who does not approve of the Interstate Commerce Commission as a proper and satisfactory safeguard of the national transportation systems.

Referring back now to the suit of the government dissolving the Standard Oil Company, it would seem that the remedy applied is of no practical value. Everyone knows that the Standard Oil Company had developed during the many years of its existence methods of production and distribution which were far ahead of anything small operators could attempt, and the fact of the matter is that the quality of the product was constantly made better and the prices, due to the introduction of economical methods, had constantly been decreased. It is equally

true that the corporation enjoyed enormous dividends and possessed the prerogative to increase them at will by merely raising the selling price of its products, after all real competition had been absorbed. It is right here where our government should have created an Interstate Oil Commission for the purpose of going into all the details of the operations of the Standard Oil Company, with powers to determine what the selling price of the various oil product should be at the different localities. That this plan is feasible and capable of extension to other monopolistic corporations cannot be denied and should apply to all corporations which have not any adequate competition. This would certainly bring about more desirable results than the dissolution of one big corporation and the creation of a large number of smaller concerns.

There is a rumor current at this time that the administration in Washington has determined to prosecute the International Harvester Company under the Sherman act. No one denies the fact that the Harvester Company is one of the most efficient producers of farm machinery, tools and implements in the world, but that does not make it a monopoly. Its trade is as wide as the grain-producing areas of the world. It is a great assistance in growing the food supply of consumers everywhere, and the demand for food is more pronounced than ever before.

Is this the time to cripple the Harvester Company by politicians who think it is popular to crush out of existence all big business? It is imperative that the food supply shall be certain and abundant. Without such great manufacturing concerns as the Harvester Company, this is impossible.

We are past the day of production on a small scale; large supplies of food are vitally necessary; they can be produced only by the use of agricultural machinery; and such concerns as the Harvester Company should be welcomed rather than destroyed.

It is self-evident to everybody, except the self-blinded politicians, that large combinations of capital, that pay good wages, can develop, manufacture and distribute better machinery, at a less cost, than the small concerns, the little foundries and machine shops, competing to put each other into bankruptcy.

From the foregoing considerations it seems clear that our present methods of handling the trust problem spell ruin for the business of this country and that it is high time that a halt be called and steps be taken to remedy present defects. We are past the stage when we required competition in every line of business; competition means increased cost of production, and in many cases inferior quality of material and workmanship. A large corporation, by virtue of its better organization and by manufacturing on a large scale, can produce a better quality of goods at a lower cost and is in this way enabled to furnish the consumer a better and cheaper article than the small shop under a competitive system. But the function of the government is to see that such a corporation does not take undue advantage of these facts and that its charge to the consumers are reasonable.

This seems best to be accomplished by the creation of an Industrial Commission having similar functions and powers regarding manufacturing as the Interstate Commerce Commission has in relation to the common carriers. If such a commission is called into existence with proper powers and proper bounds conservatively administered there seems to us no reason why this perplexing problem

should not be speedily adjusted to the satisfaction of all concerned.

Then we would have regulation, not extermination, of our important business concerns, which will keep the blood running in the veins of trade.

**An
Interesting
Irrigation
Case.**

An important decision of general interest to our readers has recently been rendered by Judge Smith of the Superior Court of California, who issued a writ of mandate directing the directors of the South San Joaquin Irrigation district to exclude eighty acres of land owned by W. B. Harleson, whose property lies within the regularly organized district.

Harleson, prior to the organization of the district, had installed irrigating pumps, run ditches and established an irrigation system on his farm. At the time of the organization of the district Harleson protested before the board of directors for exclusion, but failed to gain the exclusion sought.

In his opinion Judge Smith states that the expenditure of moneys sufficient to afford irrigation to the tract prior to district organization, coupled with the fact that exclusion was sought pending the process of formation entitles Harleson to exclusion.

This decision is no doubt based on equity, since Mr. Harleson should have been given some allowance or credit for moneys spent in developing irrigation on his holdings. On the other hand, the conditions under which the larger project was organized might mean improved irrigation facilities to Mr. Harleson, and by the same law of equity he should be willing to pay the difference to the South San Joaquin Irrigation District.

**Drainage
Problems
Require
Attention.**

The movement for the reclamation of swamp lands in the United States will no doubt receive a very important impulse at the forthcoming meeting of the National Drainage Congress, which will be held in New Orleans, La., from April 10th to April 13th. This body, though newly organized last December in Chicago, has been very active in pushing this important subject to the front and is now making good headway toward systematic work along these lines. The scope of this work covers even a greater area than the lands which can be irrigated, and the drainage problems are, as a general thing, less expensive than the problem of irrigating similar amounts of land.

Elsewhere there is a detailed statement giving the area of swamp lands within the various states of the United States which may be reclaimed by drainage. This tremendous area, nearly twice as big as the state of Illinois is, by no means all the wet land that can be reclaimed in this manner, for this shows only the larger continuous stretches and does not take any cognizance of small patches of a few acres on the various farms that might often easily be converted into very fertile and productive land by a slight expenditure of money by the individual farmers. It is safe to say that if all these small areas now forming waste lands be added to the reclaimed acreage it would swell the total enormously, and the beauty of the operation would be that legislation for its inauguration or accomplishment will be unnecessary, each individual owner solving his drainage problem in his own way, best suited his particular circum-

stances. All of these problems require study and attention and should be considered along with the greater ones, so that the final result will be satisfactory, in every way.

**Erosive
Action
of Our
Rivers.**

Few people realize that there is an almost imperceptible but nevertheless continuous process going on which in the course of time will level down all our mountains and hills and will leave finally the surface of the world slightly above the sea level, an almost level plateau, while the area of the seas will be considerably enlarged. This will be the consequence of the erosive action of our rivers, which are carrying constantly tremendous quantities of solid and saline matter from the mountains and uplands into the sea. It is estimated that the Mississippi river deposits into the Gulf of Mexico annually about 140 millions of tons of soil and salts, while the Colorado river carries two and one-half times as much matter into the Gulf of California. The geological survey of the United States discloses the fact that all the rivers of the United States taken together carry to the sea annually 270 millions of tons of saline matter and 513 millions of tons of soil. This represents something like 600 millions of cubic yards of earth; if this were spread over the total area of the United States it is found that this action will reduce the thickness of the soil on an average of one inch in 760 years.

Hence there is no immediate danger of the land being swallowed up by the sea, but the fact that such is the tendency should be borne in mind; also while the erosion is very slight on level and moderately inclined surfaces it is very much greater on hilly and mountainous surfaces, and consequently the mountains and hills are contributing the bulk of the substances which the rivers carry to the sea.

**Thoughts
That
Come
And Go**

A Parcel Post System, similar to the one in Australia, is what is needed in the United States perhaps more than any other one thing. This applies with particular force to the rural population.

* * *

In Australia the Government carries packages up to eleven pounds for 72 cents any distance, while in the United States we pay 64 cents for four pounds, with all packages above four pounds excluded.

* * *

The Farmers' Parcel Post Letter Day has been set for March 18th; this is the date on which every farmer within the United States should write a letter to his congressman demanding laws for an efficient Parcel Post.

* * *

If you miss March 18th, or if you don't read this until some later day, write anyway. Do not neglect to write your congressman in Washington that you want a Parcel Post which will deliver packages to your door for a reasonable charge.

* * *

With the rural free delivery system in operation all through the United States the extension of the Parcel Post is an easy problem; the machinery of distribution is now operating at a loss for the want of packages which might be carried practically without additional cost.

THE COLLEGEPORT IRRIGATION PUMPING PLANT

R. C. Wise.*

Very much has been written and said about irrigation by pumping. Yet there does not appear in public prints a great deal about pumping plants of large sizes that is noteworthy. Possibly this is because the very large pumping plants are not numerous. Possibly also because after a pumping plant is once completed and put in operation there is not much about it to hold any further the interest of the technical irrigationist or engineer—to say nothing of the photographer, who finds a very ordinary building covering the "subjects," and dark corners hiding what is not actually put under ground.

However much of truth there may be in these assertions, it is something of a pleasure to find once in a while a case which is interesting by contrast, and convincing on further study.

The view herewith (Fig. 1) of an interior taken during erection makes it easy to understand an irrigation pumping plant of considerable note erected for the Collegeport Canal Company, on the Colorado River, about ten miles above Matagorda, Texas.

Duty.

The nominal capacity of this plant is 150,000 gallons per minute, which means that when pumping water at this rate, it would cover an area equal to about $5\frac{1}{2}$ acres, one inch deep, each minute.

The average lift, depending on the stage of the river, is 23 feet. The amount actually pumped may vary, as will be explained further on.



Fig. 1. Pumping Plant of Collegeport Canal Company. Two 48-inch Morris Machine Works Centrifugal Pumps; Nominal Capacity, 150,000 Gallons Per Minute. Driven by Erie Tandem Compound Four-Valve Engine. One Unit Running. View During Completion of Building. Condensers in Background.

*Mechanical Engineer for Henion & Hubbell, Chicago.

Main Pumps.

Standing prominently in the foreground is one of the two pumps used to do this work. Briefly, it is a 48-inch discharge "Morris Machine Works" double-suction centrifugal pump, arranged for direct connection to an engine. The two suction pipes extend horizontally through the wall into the suction bay, then downward within a protective cribbing, as shown by Fig. 2.

The water drawn in through both pipes, passes the elbows and is received on both sides of the pump impeller or piston, balancing it against any thrust. The discharge is from the lower portion of the pump shell in the opposite direction from the suction, underground. This arrangement puts it out of the way in the power house.

Pump Shell.

The pump shell or volute is split both horizontally and vertically. The horizontal division extends, as will be seen, through the suction elbows and elbow bearings. This manner of dividing the pump shell has been used many years on the large Morris pumps and has recently come into considerable favor also for smaller ones on account of marked advantages.

A ribbed divided disc is attached to each side of the pump shell. Bolted to these discs are suction elbows, carrying ample shaft bearings. Beyond this is an outboard shaft bearing. This provides a large amount of bearing surface, which means long life to any pump, and has been one of the valuable qualities of this make since its first appearance some 45 years ago.

The regular shape of the pump volute, increasing all the way round to the discharge, is clearly brought out by the photograph. This indicates a well-shaped interior water passage, which together with the design of the impeller or piston, and the careful interior finish, are extremely important points in the general efficiency of the pump.



Fig. 2. Oil Barge Unloading. Suction Pipes for One of the Pumps and Protective Cribbing. View of Stream Supplying Water for the Pumps.

Priming.

Priming pipes are attached at the top of the pump shell and were so arranged when the photographs were taken that one steam ejector, conveniently located, served both pumps.

Suction and Discharge Piping.

The suction and discharge piping was laid out especially to avoid water friction—always a sort of hydraulic "bugaboo." The pump opening for the discharge is 48-inch, but the piping leading from it is increased to 60-inch. By this means the pipe friction is reduced to one-third or one-half what it would be for 48-inch pipe, making it a strong point in plant economy. The termination of the discharge piping is an oblong discharge nozzle, made very wide horizontally, but very shallow vertically. The effect of this is to spread the discharge into a fan-shaped stream, which leaves the opening at decreased velocity, and which under certain conditions slightly reduces the actual working head on the pump. It also utilizes to better advantage the momentum of the outward moving water body.

Sharp turns have been entirely eliminated. Where necessary to change direction of the water, the piping has been made on easy sweeping curves. On the discharge these were formed to a 15-foot radius; on the suction to a 10-foot radius. Fig. 2 shows the part of the turn in the suction pipe which is above water. At the bottom end the openings are flared to produce easy entry conditions.

Fuel.

In Fig. 2 is also noted the solution of the fuel problem as a barge of crude oil is being unloaded by steam.

Condensers and Circulating Pump.

Two 14-inch Baragwanath siphon condensers are used for creating the vacuum for the main steam engines. Water for these condensers is furnished by a "smaller member" of the Morris centrifugal pump "family," consisting of an 8-inch discharge centrifugal pump, direct-connected to an 8x5 Morris high-speed enclosed self-oiling engine. This outfit is adapted to high speeds and will work against higher heads than the ordinary open-type, long-stroke vertical engine will stand. It is shown in operation (Fig. 3). The condensers to which it delivers may be seen in Fig. 1 surrounded by framework in the background.

Engines.

The main driving engines deserve a word.

The conditions under which most irrigation and drainage pumping plants are operated make it a problem as to what style of engine to use. As they usually run but part of the time—three or four months of the year—the engine must not be overexpensive; nor require many repairs; and upkeep must be low. On the other hand, to use the less costly, simple engine makes the fuel bill frequently prohibitive, because they require too much steam. Therefore some measure of steam economy must be attained, and to do this the engine must be compounded. It must not be too delicate. It must not be too complicated. It must do well under the care of unexpert attendance. Between these extremes it is often hard to decide. The engine chosen for this plant, the Erie City tandem compound four-valve engine, possesses a well-balanced average of these qualities. The usual construction of the steam end, the vital part, is with a balanced slide valve for the steam inlet, and rotating valves operated by a separate valve rod through suitable rockers and links for the exhaust. The design has been worked out so as to have small clearance and to allow the exhaust a direct and free passage.

The governor shown in the illustration does not control the speed of the engines, but acts simply as a safety stop. The work being practically constant for each run, there is very little call to change speeds. Sufficient adjustment may usually be had at the throttle. These engines have adjustable eccentrics by which the cut-off may be changed to suit variations in load which may arise from changes in water level or other requirements. The flywheels, pump pistons and body of water in the pump itself all act to produce an even rotation of the combined unit.

Summary.

The following presents a brief outline of the principal apparatus used in this plant:

Two 48-inch Morris Machine Works centrifugal pumps arranged with flexible shaft couplings for direct connection to steam engine.

Two Erie City 17x34x30 tandem compound four-valve engines. Speed 120 to 160 revolutions per minute.

Two Erie City vertical water tube boilers with individual stacks; full fronts; brick setting; 350 horsepower each.

One vertical boiler of 20 horsepower for starting oil burners and for washing out main boilers.

Two 14-inch Baragwanath siphon condensers.

One open-type feed water heater and purifier of 1,000 horsepower size.

One No. 8 Morris centrifugal pump, direct connected to an 8x5 Morris enclosed high-speed self-oiling engine to supply water to condensers.

Two 12x7x12 Burnham single cylinder boiler feed pumps.

Two 5x3x6 Burnham single cylinder steam pumps for handling fuel oil for burners.

The equipment, design and erection of this plant were under the direction of Mr. H. A. Paine, Houston, Texas. Its operation proved so satisfactory that it was accepted without test.

20,000,000 farmers, operated at an estimated cost of about \$42,000,000 for the year 1912. The stamps canceled on the mail matter taken from the rural mail boxes the present year will amount to rather less than \$8,000,000, leaving an apparent deficit of over \$34,000,000 for the year 1912. It is hardly fair to call the latter sum the real loss, because the rural routes should be credited with part of the postal receipts on mail the farmers receive. If each rural carrier could earn 10 cents daily by carrying packages, the total returns for 42,000 carriers would be about \$1,250,000 annually. They should earn many times this small sum, besides benefiting all parties concerned. The average outward rural mail load is 25 pounds and the return about five pounds; it could and should be ten or fifteen times that. The rural mail carriers have petitioned the government to let them render greater service. No other business is conducted on such narrow lines.

The adoption of the rural mail service was one of the most beneficent acts ever placed on the statute books by congress. To round out and complete our postal system, there is needed a liberal parcel post service. Our people can have this from the present congress if they ask for it.

The only efficient way of working is to write letters to members of congress telling what is wanted, and getting neighbors to write.

Do not forget that March 18, 1912, is Farmers' Parcel Post Letter Day.

WYOMING'S IRRIGATION STATISTICS.

The total number of farms irrigated in 1909 was 6,297, against 3,721 in 1899, an increase of 2,576, or 69.2 per cent. Between 1899 and 1909 the number of all farms in the state increased 59.1 per cent. The per cent of the whole number of farms irrigated in 1909 was 57.3. In 1899 the per cent was 53.9, showing an increase in per cent during the 10 years of 3.4.

The total acreage irrigated in 1909 was 1,133,302 acres, against 605,878 acres in 1899, an increase of 527,424 acres, or 87.1 per cent. The irrigated area extended more rapidly than the improved area, which increased 58.5 per cent during the 10 years.

The total acreage which all enterprises were capable of irrigating in 1910 was 1,639,510 acres, an excess of 506,208 acres over the area irrigated in 1909. The area included in projects either completed or under construction in 1910 was 2,224,298 acres, an excess of 1,090,996 acres. This indicates in a general way the area which will be available for the extension of irrigation within the next few years and shows that the area irrigated in 1909 can be nearly doubled without undertaking new enterprises.

The number of independent enterprises reported in 1910 was 5,577. The total length of all ditches was 13,231 miles, of which 10,933 miles were in main canals and 2,298 miles in laterals. The length of main canals reported in 1899 was 4,454 miles, showing an increase in the 10 years of 6,479 miles, or 145.5 per cent. The number of reservoirs reported was 415, having a combined capacity of 2,550,937 acre-feet. The number of wells pumped for irrigation was 3, and the number of all pumping plants was 34. The engine capacity of pumping plants was 703 horsepower. The acreage irrigated with pumped water was 1,615 acres. Flowing wells supplied water to 64 acres.

The total cost of irrigation systems reported in 1910 was \$17,700,355, against \$3,956,692 in 1899, an increase of \$13,743,663, or 347.4 per cent. The average cost per acre in 1910 was \$10.80, against \$6.54 in 1899, an increase of \$4.26, or 65.1 per cent. The average cost of operation and maintenance per acre in 1909 was 86 cents, against 16 cents in 1899, an increase of 70 cents, or 437.5 per cent.

The acreage irrigated in 1909 has been classified according to the state and Federal laws under which the works were built or are operated, as follows: United States Reclamation Service (act of congress June 17, 1902), 12,905 acres, or 1.1 per cent of the total; United States Indian Service (various acts of congress), 4,270 acres, or 0.4 per cent of the total; Carey Act (act of congress August 18, 1894), 86,252 acres, or 7.6 per cent of the total; irrigation districts, 11,800 acres, or 1 per cent; co-operative enterprises, 116,317 acres, or 10.3 per cent; commercial enterprises, 87,935 acres, or 7.8 per cent; and individual and partnership enterprises, 813,823 acres, or

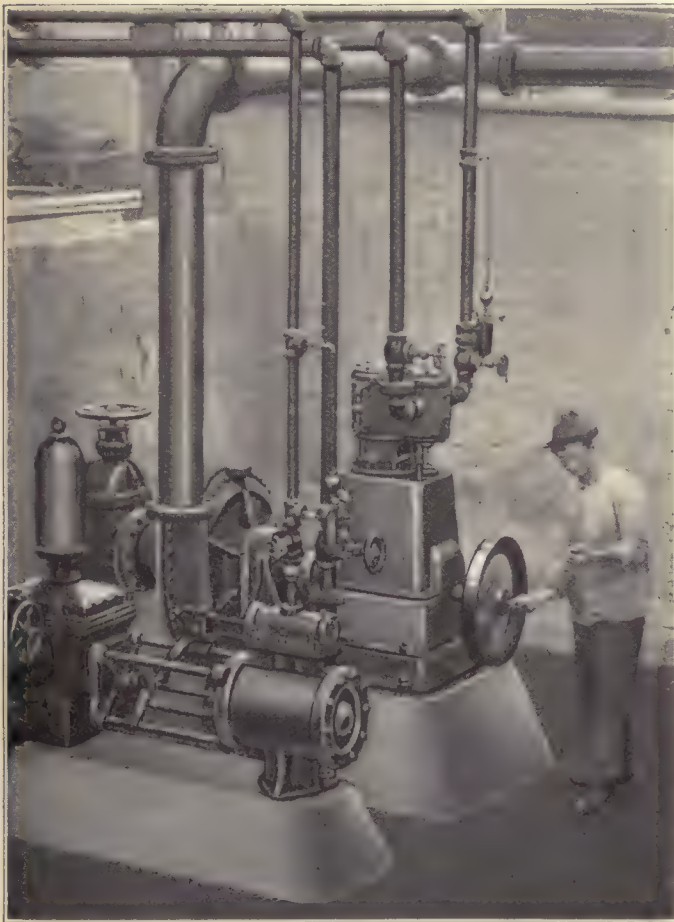


Fig. 3. Corner of Pump Room. Pump in Operation Supplies Water to the Siphon Condensers and Consists of a "Morris" High-Speed Enclosed Engine and Centrifugal Pump Direct-Connected.

ADVANTAGES OF A PARCEL POST.

With a low carrying charge on rural routes and within the first zone, the farmer will be able to order by telephone or postal card, and quickly obtain from nearby places of business, medicines, drugs, groceries, bread, dry goods, seeds, plants, small implements, tools, bolts, plow points, parts of machinery, etc., also books from the library. In turn he can send to merchants and individuals in nearby cities and villages many of the smaller and lighter products of the farm, garden, green house, poultry yard, etc.

There are now 42,000 rural mail routes, serving about

71.8 per cent. United States Reclamation Service and Carey Act works are to be turned over to the water users for operation and maintenance as soon as they are paid for. Including these, 91.8 per cent of the acreage irrigated in 1909 was supplied by works controlled by the water users.

Streams supplied 1,113,774 acres, or 98.3 per cent of the total acreage irrigated in 1909; lakes supplied 120 acres, or less than one-tenth of 1 per cent; wells supplied 139 acres, or less than one-tenth of 1 per cent; springs supplied 3,008 acres, or 0.4 per cent; and reservoirs supplied 14,261 acres, or 1.3 per cent.

UTAH'S IRRIGATION STATISTICS.

The total number of farms irrigated in 1909 was 19,709, against 17,924 in 1899, an increase of 1,785, or 10 per cent. Within the same period the number of farms in the state increased 11.8 per cent. The per cent of the whole number of farms irrigated in 1909 was 90.9. In 1899 the per cent was 92.5.

The total acreage irrigated in 1909 was 999,410 acres, against 629,293 acres in 1899, an increase of 370,117, or 58.8 per cent. The irrigated area extended more rapidly than the improved area, which increased during the 10 years by 32.6 per cent. The total acreage which all enterprises were capable of supplying with water in 1910 was 1,250,246 acres, an excess of 250,836 acres over the area irrigated in 1909. The acreage included in projects either completed or under construction in 1910 was 1,947,625 acres, an excess of 948,215 acres over the area irrigated in 1909. This indicates the area which will be available within the next few years for the extension of irrigation, and shows that the area irrigated can be almost doubled without the construction of additional works.

The number of independent enterprises reported in 1910 was 2,472. The total length of all ditches was 7,562 miles, of which 5,764 miles were in main canals and 1,798 miles in laterals. The length of main canals reported in 1899 was 2,838 miles, showing an increase in the 10 years of 2,926 miles, or 103.1 per cent. The number of reservoirs reported was 482, having a combined capacity of 588,317 acre-feet. The number of wells pumped for irrigation was 27 and the number of pumping plants 70. The engine capacity of pumping plants was 1,833 horsepower. The acreage irrigated with pumped water was 2,859 acres. Flowing wells supplied water for 4,100 acres.

The total cost of irrigation systems reported in 1910 was \$13,844,943, against \$5,722,306 in 1899, an increase of \$8,122,637, or 141.9 per cent. The average cost per acre in 1910 was \$13.85, against \$9.09 in 1899, an increase of \$4.76, or 52.4 per cent. The average cost of operation and maintenance per acre in 1909 was 65 cents, against 24 cents in 1899, an increase of 41 cents, or 170.8 per cent.

The acreage irrigated in 1909 has been classified according to the state and Federal laws under which the works were built or operated, as follows: United States Indian Service (various acts of congress), 11,520 acres, or 1.2 per cent of the total; Carey Act (act of congress, August 18, 1894), 5,000 acres, or 0.5 per cent of the total; irrigation districts, 8,455 acres, or 0.8 per cent; co-operative enterprises, 681,760 acres, or 68.2 per cent; commercial enterprises, 70,227 acres, or 7 per cent; and individual and partnership enterprises, 222,448 acres, or 22.3 per cent. The United States Reclamation Service is now engaged in the construction of a large project, which will ultimately irrigate an area of about 65,000 acres, and will take over about 20,000 acres which in 1909 were irrigated by co-operative or partnership enterprises. Carey Act works are to be turned over to the water users for operation and maintenance as soon as they are paid for. Including these, 91.8 per cent of the acreage irrigated in 1909 was supplied by works controlled by the water users.

Streams supplied 957,359 acres, or 95.8 per cent of the total acreage irrigated in 1909; lakes supplied 1,671 acres, or 0.2 per cent; wells supplied 4,400 acres, or 0.4 per cent; springs supplied 35,412 acres, or 3.5 per cent; and reservoirs supplied 568 acres, or 0.1 per cent.

DO IT NOW.

Remit \$2.50 for the "Primer of Hydraulics," cloth bound; it is ready now.

WANTED—A REAL PARCEL POST.*

Do you know, reader, that in carrying packages by mail our government actually discriminates against its own people in favor of other nations? Such is the case and here are the facts:

Our post office department at Washington has "conventions," or agreements, with 29 other nations by which it carries packages weighing up to 11 pounds from any post office in this country to any post office in those countries for 12 cents per pound. For 12 cents a pound you can mail from your post office packages weighing up to 11 pounds to London, Berlin, Vienna, Stockholm, Rio Janeiro, Valparaiso, Jerusalem, Melbourne, Tokio, Peking, Mukden and to more than 10,000 other foreign post offices scattered all over the globe. But a package mailed to the next town in the United States must not exceed four pounds in weight and the carrying charge is 16 cents for each pound.

And as though these discriminations were not enough, our postmaster-general has made arrangements with British post office authorities recently whereby mail packages up to 11 pounds are carried from any post office in England, Scotland, Ireland or Wales to any post office in the United States for the following charges:

Up to 3 pounds, 30 cents.

Up to 7 pounds, 55 cents.

Up to 11 pounds, 79 cents.

By this agreement a British subject can send 11 pounds in one package from his post office to your post office for 79 cents; while you wishing to mail matter weighing 11 pounds to your nearest post office in this country must break it up into three packages of not over four pounds each and pay \$1.76 postage—a discrimination of 100 per cent against you.

As allowed by law, the postmaster-general is steadily extending these special postal privileges to foreign nations. This is right and best for all concerned.

On the other hand, the only change congress has made in carrying parcels for our own people during the last fifty years is that in 1875 it raised the postage on parcels from 8 to 16 cents per pound, i. e., doubled the cost.

Several parcel post bills are now before congress, and the senate committee on post offices and post roads, Jonathan Bourne, chairman, is hard at work gathering all available information on the subject. It is reasonable to believe that ere long, when the data have all been gathered and duly considered, the senate committee will announce a new bill, acceptable to all who desire a reasonable parcel post.

Congress should provide a parcel post service somewhat as follows:

(1) Carry packages originating and ending on the same rural route at a nominal cost, because the income therefrom would be nearly all profit to the government.

(2) Establish parcel post zones, or circles, of 50, 200, etc., miles radius from each post office. Make a low carrying charge within the first zone, because of the short haul and the large volume of business that would result.

(3) Enlarge the weight limit on parcels carried on rural routes to not less than 25 pounds, and elsewhere to not less than 11 pounds.

A HINT TO COTTON GROWERS.

Cotton importation has shown a steady if not rapid growth, especially during the last 20 years. Prior to the Civil War the quantity imported seldom reached more than 1,000,000 pounds per annum. During the war the quantity imported was quite large, ranging as high as 30,000,000 pounds in 1865, but dropping to 6,000,000 pounds in 1866, and less than 1,000,000 pounds in 1867. By 1870 the total importation of cotton was 1,670,000 pounds; in 1880, 3,500,000; in 1890, 8,500,000; in 1900, 67,000,000; in 1910, 86,000,000, and in 1911, 113,750,000 pounds.

*By W. A. Henry, formerly dean of College of Agriculture, Madison, Wis.

NEW MEXICO BUREAU OF IMMIGRATION

The rapid movement of homeseekers within the last decade to that part of the United States lying west of the one hundredth meridian—roughly speaking—has within that period, and in view of the changes that have been wrought, transforming the old "west" into that of today, brought about a new set of problems. The haphazard methods sufficient at one time—of relying upon one's personal initiative and upon too frequently unreliable gossip in lieu of accurate information—are no longer practicable. In the vital matters of selection of a home and of a field for the cultivation of one's destiny and the rearing of a new generation of Americans, the old axioms that "it is better to be safe than to be sorry," and "the time to correct mistakes is before they are made," are of peculiar significance.

It is true that the Federal government; in other words, the people at large, has placed for almost a half century the unoccupied lands of the west at the disposal of its citizens, through the agency of well-known "public land laws," for the purposes of home building, in contravention of the doctrines accepted during the first half of the nation's existence, that the public lands were to be regarded as a source of immediate revenue. No provision has ever been made for the dissemination of accurate information by Federal agency bearing upon the questions of vital interest to the homeseeker or investor, with reference to the great "West" as a whole, and it is perhaps well that it is so, since paternalism can be carried to an extreme.

In view of the greatly restricted area left of the public domain, as compared with that of ten years ago, the increase in area in private ownership and of development of irrigation, bringing with it a new set of conditions, the resources of the individual can no longer be regarded as sufficient, in themselves, in deciding questions of such moment, except at prohibitory expense.

To meet the requirements of the changed status of affairs a number of the individual Western states have assumed, in a wholesome spirit, the moral obligation of providing the inquirer with data upon whose reasonable accuracy he may rely. This has been accomplished, where the system has been inaugurated, through the appointment, by legislative enactment, of an official or set of officials whose duty it is to collect data regarding the resources of the state, whether agricultural or otherwise, in a spirit of disinterestedness and to place these at the disposal of those interested as a fund of reliable information. It needs but little reflection upon the part of any one familiar with the complexities of homeseeking and with conditions in the "West" to perceive the advantages of such a system of states' intervention as opposed to any attempt upon a wholesale scale. It is not contended that Federal agencies cannot be made of value—for example, in the direction of diverting immigration through our seaports to unoccupied lands, nor that the Departments of the Interior and of Agriculture are not performing valuable service in this direction, but that the data collected by these agencies are of greater value when localized than when presented in the aggregate. The majority of citizens whose minds are fixed upon the West today are led, for a variety of reasons, to center their thoughts upon some definite section, proximity of friends, well-known advantages of soil, climate or government policies entering into consideration. Under these conditions and with the ample and gratuitous advice and assistance of these state functions it is made a comparatively easy matter for the person gifted with average intelligence to arrive at a satisfactory choice at a minimum expenditure of cash and time. This is all the more true because of the enlightened policy pursued by the transcontinental railroads also—that of providing very low rate excursions to practically every point west of the

Missouri river with time limit ample for thorough investigation.

The former territory of New Mexico has long held a place in the world's eye by reason of its vitalizing air and sunshine, its stock ranges and mines, its enchanting scenery and fascinating antiquities and, in a lesser degree, to its agricultural advantages. With its admission to the sisterhood of states, renewed attention has been diverted to it and interest as to its resources and advantages is assuming broad dimensions. It is recognized that statehood releases the former territory from a number of restrictions that have operated to deter development and to disarm confidence. The constitution adopted is conceded by authorities to be a model of restrained enlightenment. Under its ample provisions the man of capital may feel secure from paralyzing legislative enterprises and free to invest his money in the legitimate enterprises of development, while the man of minor financial ability is protected by the machinery provided to secure him from exploitation. At this stage, when so much interest centers upon the new state and with the reviving influence of the new condition manifest, it is fortunate that the territory, long since, created the "Bureau of Immigration," which as today constituted, comprises six citizen members recruited from various points of the state and appointed by the governor with the confirmation of the senate. The bureau maintains an office and exhibit rooms at Albuquerque with an organization consisting of a permanent secretary and staff. The secretary, who is elected by this board, acting as its executive officer, the other members convening as occasion may require. No member of the bureau has any interest in any project that could derive benefit from its activity. The bureau, through its secretary, is continually collecting and publishing valuable data and spreading these in the form of reports, bulletins and other means of publicity, through the mails and otherwise. At present the membership is as follows: George L. Brooks, Albuquerque; John A. Haley, Carrizozo; W. Goff Black, Aztec; M. M. Padgett, Las Vegas; L. K. McGaffey, Roswell; Howard H. Betts, Silver City; H. B. Hening, secretary, Albuquerque. The present secretary has held this office during the past four years and is widely and favorably known throughout the Southwest.



H. B. HENNING,
Secretary New Mexico Bureau of Immigration.

His able and accurate presentations of the resources of the state are to be recognized in the interesting bulletins published by the bureau. The bureau during the past has been limited to the work as outlined. It is confidently expected, however, that the legislature, which is now in session, will provide largely increased appropriations, enabling the bureau greatly to amplify its scope of operations and to collect statistics in systematic fashion. The policy of the bureau has been, consistently, that of co-operation with the railroad immigration departments and with such land and irrigation companies as are demonstrably reliable, only. Little can be presented in an article of the scope to which this is limited about the state itself—which many thousands of California tourists know only as observations are possible from the car platform and which—from the tourist standpoint—contains marvels of wonder and interest to be seen in no other section of the country. The state has long, and justly so, been famous for its climate. A few cardinal facts may be presented, however—some well known, others known to a lesser degree. The state is one of the largest in the Union, containing, in round numbers, 78,000,000 acres, ranging in altitude from 3,100 feet above sea level to the 13,000 foot level of some of the mountain peaks. With its varied topography it embraces climatic conditions in variety, equalling even California itself. The state, through territorial grants and the new grants provided in the Enabling Act, is endowed with an enormous estate of land to be selected, and in fee, totaling 12,000,000 acres of which amount the revenue of 10,000,000 acres is irrevocably dedicated to educational purposes. It will be seen that ample funds will accrue to the state for these purposes from the lease and sale of these lands. The father of a growing, or prospective, family will know how to value this feature. As much of the remaining public domain is embraced in forest reserves or is already "entered" the state will have the right of lien selection from the best of the remaining lands. The old Spanish and Pueblo Indian grants number between six and seven hundred with an area of approximately seven million acres.* While the Indian grants are not subject to disposal, the titles to all of the Spanish grants have been confirmed and they are being partitioned for sale and rapidly passing into American ownership. As these grants, under Spanish dominion, were selected from the best lands lying along water courses in Central and Southern New Mexico and include valuable grazing and timber lands, they offer in many instances fine opportunities for the investment of capital for agricultural, mineral or timber development. The national forests also afford abundant opportunities for the lumberman. The American Lumber Company—by way of an interesting example—operates at Albuquerque one of the largest mills in existence with capacity of 300,000 feet daily. Last year 700,000 railway ties were floated down the Rio Grande, a distance of 120 miles, to the Domingo railroad station. The national forests contain also much land available for homestead entry under forest reserve regulations.

The public lands open to homestead and desert entry having been largely filed upon, attention is being focused upon the more valuable irrigated land. Irrigation in New Mexico has been almost uniformly successful and the state has had but few failures of large irrigation projects, owing to the enactment, in 1907, of a thoroughly good code of irrigation laws and to their conservative administration. Irrigation by pumping and from flowing wells also has been the means of successfully reclaiming much excellent land and the state has been enlightened enough to adopt a model code of laws governing flowing wells. Opportunities to secure good land at reasonable figures exist in several proven districts of artesian flow and shallow water-pumping, where necessary, being done with individual plants—power being supplied independently, or from a central power station. In the well known Pecos valley there are at the present time some 700 flowing wells and there is a large area outside of the zone of these wells where an ample supply of water can be secured with a maximum lift of 40 feet. In the Portales district, in central eastern New Mexico, 10,000 acres are ready to be served with power furnished from a central station; in the Deming district, in southwestern New Mexico, an estimated total of 200,000 acres is available for this service. Abundant opportunities for irrigation by low-lift pump-

ing are to be found in the "first bench" lands of the Rio Grande valley from the central part of the state to a point not far from its northern boundary, the soil being an alluvial deposit of inexhaustible fertility and requiring only the planting of nitrogenous crops.

Prices of lands irrigated, or to be irrigated, are still very reasonable—raw lands in proven fruit districts commanding from \$50 to \$100 per acre. Apples can be grown successfully in almost any part of the state where the altitude exceeds 3,500 feet. The successes achieved in the Pecos valley and in San Juan county in this direction are too well known to require mention.

The Carlsbad government project in the Pecos valley and the first unit of the famous "Rio Grande" project—the 25,000 acres tributary to Las Cruces, served by the "Leasburg" dam—have amply justified the anticipations of the water users. With a reliable water supply during the past four years, unrivaled soil and climatic conditions, and long growing seasons, profitable crops are practically assured while "excess holdings" under both projects can yet be secured at a reasonable figure. With great areas of fertile land upon which water can be placed, with diversities of climate favoring the growing of a wide range of crops, with the opportunities for stock raising upon the range and within the national forests, for lumbering and mining, the state needs only capital and an influx of citizens to make it a fit abiding place for the best American stock.

H. B. Hening, to whose ability and industry the state owes much, is not a native, but emigrated to New Mexico from New York state after graduating from Syracuse University some ten years ago, his health having suffered from too close application to studies. His first occupation was upon the range as a cow-man, after which he was employed upon the staff of the Albuquerque "Morning Journal" until four years ago when his recognized standing as a publicity expert led to his appointment to his present office.

IRRIGATION AND CULTIVATION OF POTATOES.*

BY JOHN M'PHERSON.

Burbank potatoes do not grow as well and keep their shape as well in clay soils as in sandy soils. If you have a sandy soil, good drainage and good cultivation, a Burbank potato would not be objectionable.

Any of the long potatoes have a tendency to grow large.

Have moisture in the soil when potatoes are put in the ground.

The first cultivation of potatoes should be deep—about 8 inches. This gives a good seed bed and makes a reservoir for holding water.

The first irrigation would depend upon the amount of moisture in the ground at the time potato was planted.

Under reasonable conditions potatoes should not be irrigated until June 1st.

After each irrigation there should be a cultivation.

There is just one time to cultivate and that is when the soil is not too wet or too dry—when the soil will fall off the cultivator blade.

Get away from as much water as possible and use cultivator.

Use cultivator first, and when hilling up potatoes use single shovel plow after cultivator.

When you can see the rows well get in there with cultivator.

When you water potatoes give them a good one, but do not saturate the soil. Turn water in and let it run until you find down about 2 inches there is dry soil, and below that it would be moist to the hill.

Cultivation will check dry rot.

Dry rot appears when ground is kind of damp and the plant is making a vigorous growth.

Leave potatoes unhilled as long as possible without cultivating.

Do not let last irrigation be a heavy one, but at all times keep potatoes in even moisture.

I do not think it is advisable to plant potatoes on new land for commercial purposes.

*From Bulletin No. 1, Movable Schools of Agriculture, University of Idaho, issued by the Hub City Irrigationist, Wendell, Idaho.

A NEW DEPARTURE IN FLUMES.

No more wooden flumes, always leaking, warping, rotting out, but the modern durable metal one, without any cross bars to catch drifting weeds, etc., which often dam up and spill over sides undermining trestle work.

Simplest flume ever constructed.

Most easily and convenient to erect on trestle work. Two men can place from 300 to 1,000 feet per day. Only two nuts to tighten at each joint.

The ideal flume for bench work, as thousands of feet of clear unobstructed passageway for water may be had without any danger of weeds, etc., that naturally drift into same, clogging it up.

Where the corrugated flume is used there is practically no sand or gravel left in it after turning water out. In the flume erected for the Stratton Estate, Colorado Springs, illustrated in the appended cut, there was not over one pound of sediment to each 4 feet on a grade of 1 foot to the thousand. This means no extra weight for the trestle to bear, and no labor clearing flume.

"Every flume guaranteed, every customer satisfied, and every drop of water saved" is our motto.

The damming up of the wooden flume on the inventor's ditch by tumble weeds lodging on a cross-bar and spilling over sides of same, undermining trestle work and costing considerable labor and loss of two or three days' irrigation water at a dry time, was the means of conceiving the idea of a "no cross-bar" flume. Its instant success and universal approval by irrigationists indicates that it is only a question of time until it will be the only style flume used in small or medium sizes. Its principal advantages being its doing away with wooden cross-bars which are a great expense and are often clogged or dammed up by drifting weeds, etc.

This flume is manufactured in all sizes from 12 inches up by The Colorado Ingot-Iron Pipe & Flume Co., at Colorado Springs, Colo.

Supreme Court Decisions**Irrigation Cases****DAMAGES FOR FAILURE TO SUPPLY WATER.**

On suit for breach of defendant's contract to supply plaintiff, a tenant, with water for a rice crop, it was error to authorize recovery of a share of the additional amount of rice which would have been raised if the land had been properly irrigated. *Lone Star Canal Company v. Cannon*. Court of Civil Appeals of Texas. 141 Southwestern 799.

WATER COURSE.

Whenever surface water flows in one continuous, well-marked channel, it becomes a "water course," if this regularly recurs each season. *Borman v. Blackmon*. Supreme Court of Oregon. 118 Pacific 848.

CREATION OF IRRIGATION DISTRICTS.

The legislature may by statute passed without notice or hearing create an irrigation district, or it may delegate the power to do so to a local board to be exercised on specified conditions, and on the ascertainment of specified facts by such board after notice and hearing to the parties interested. *Imperial Water Company No. 1 v. Board of Supervisors of Imperial County*. Supreme Court of California. 120 Pacific 780.

ADVERSE POSSESSION.

The use of a ditch for a prescribed period under circumstances making it adverse, open, exclusive, and under claim of right, gave title by prescription, though claimants never owned any water rights, but leased the water flowing through the ditches. *McDonnell v. Huffine*. Supreme Court of Montana. 120 Pacific 792.

(Continued on page 180.)



A No. 98 Flume Erected for the Stratton Estate, Colorado Springs. Capacity 40 Cubic Feet Water per Second on a Grade of Five Feet to the Mile.

DEMING, NEW MEXICO

IRRIGATION NEWS

NEW MEXICO AND THE MIMBRES VALLEY.*

In this age of unrest and when social and economic conditions press ever more heavily upon the producing and intermediate classes, the air is full of panaceas, doctrines and dogma, but the solution of the riddle of the sphinx—to be applied wholesale—is still to be found.

It is useless to expect the application of any doctrine of political or social economy to release the worker of the cities or the tenant, or fee-simple-farmer of the worn-out acres of the East or Middle West, from industrial bondage, not, at least, within the span of life of those to be benefited now. The only solution, so far available, remains the one that has stood the test of the ages—individual effort—but the centralization of industries has greatly minimized the opportunities for betterment of self in the commercial and industrial spheres of action.

It requires but little reflection upon the underlying causes to determine that the "back to the land" movement is not a fad but is founded upon correct basic principles. If an argument of more direct application be demanded, let the constantly increasing cost of food-stuffs and the ever-widening breach between production and consumption supply material for the answer.

Given the right conditions and farming—today almost in the irrigated sections—an exact science—can be made one of the most gainful of occupations as it already is the most normal and healthful.

This remark is addressed with equal force to the farmer east of the 95th meridian and to the "city man" cramped and stifled for lack of an horizon.

What is the solution—not academically—but in a practical way? The virgin soil. It is not to be assumed that all who "return" to the soil will make the experiment succeed, failures in a constantly decreasing ratio are to be expected here, as elsewhere, but such failures cannot be attributed to economic defects—the opportunities are there—latent, but at every man's hand.

The question then resolves itself into one of very concrete proportions, viz: "Where can I find the right conditions out of the mass of material thrust upon my attention?"

Many people are disposed to deplore the passing of the good old days when Uncle Sam had a farm for everyone—unaware that the pioneer of thirty and forty years since paid a price greater, in a score of ways, for his "160" or "320" than does the homeseeker of today whose path of inquiry, settlement and development is made easy in the multitude of ways devised in the advancement of the last quarter-century. Uncle Sam still has land for the hungry, but the conditions of twenty-five years ago—at that time without a parallel in the history of civilization, no longer exist. The eyes of the homeseeker are still turned toward that West of glow-

ing promise and fulfillment, but with an increased knowledge of conditions, the question is no longer "where can I get something for nothing," but "where may I secure title to land that is productive, at values not inflated beyond earning capacity, and where transportation facilities and markets are such that I may convert the products of my labor into real money; where livable conditions of a twentieth century standard exist and the horrors of old-time pioneering need not rob this generation of the joys of living for the benefit of future peoples; where a real water-right instead of a 'fictitious wrong' may be secured as a basis for that irrigation without which, except in a few negligible instances, intensive farming of small tracts west of the 100th meridian is impossible."

It is the purpose of this article to set forth the merits of one of those districts which are called "new" in the light of abundance of virgin opportunities and real advantages.

First of all, what are the factors necessary to successful farming which provide a decent living? In all localities, irrespective of latitude or longitude, the right soil conditions—fertility in the original sense and in the supplementary method of replenishment as well, by rotation or growing of nitrogenous crops, and in an irrigated region, especially good natural drainage, good water storage capacity, absence of alkali in injurious amounts, climatic conditions, long growing seasons, absence of killing frosts at unseasonable periods, of destructive winds, and for plants and humanity alike—sunshine and equability. "Plants need sunshine and good air to thrive, so does man" is an axiom. Transportation and markets—good wagon roads over a level country; steam roads affording easy access to cities and to markets of stable purchasing power at a non-competitive distance and with demand for the profitable luxuries of the table—fruits and vegetables as well as hay and dairy products. Water—good water for domestic and stock use, and of paramount importance—good water free from injurious chemicals, seeds and organic matter, in ample quantity to be used when and where needed, and under a fee-simple and infeasible title for irrigation. Add to these physical factors the other necessities of enlightened living such as are afforded by proximity to modern cities, and we have the ideal conditions of life in an irrigated section fulfilled.

The writer will, therefore, endeavor to set forth, from the most authentic sources available, the conditions in a well-known section of New Mexico—the Deming District. It is assumed that the intelligent investigator of this era is not eager for glowing "hot air" panegyrics, but facts—buttressed by expert and disinterested testimony. So far as this district is concerned there is, fortunately, plenty of reliable evidences at hand in the form of government investigations, and the reports of these upon all pertinent facts, supplemented where necessary by personal studies of other disinterested parties, as herein set forth, are the authority for all statements presented—the exact phraseology being borrowed at times. These citations are as follows: Senate Document No. 41, Fifty-second Congress, First Session, page 224; L. Clapp, Jr., Engineer, Office of Experiment Sta-

**Editor's Note:—This is the first of a series of articles to be presented to our readers from time to time, dealing with the agricultural and other resources of the country at large—particularly of those irrigated districts of proven merit where real opportunities exist. They will embrace the results of careful observations of a traveling correspondent—a man whose familiarity with all phases of western development places him in the first rank as an authority upon these subjects.*

None but districts or projects of demonstrated value will be described, the policy of the IRRIGATION AGE being to make these articles sources of real information and assistance to those interested.

tions; United States Department of Agriculture, August 14, 1911, P. E. Fuller, Engineer; Report of Territorial Engineer of New Mexico, 1909-10, V. L. Sullivan, Engineer; Engineer R. H. Case, engineer in private practice. All these documents are of a public nature. While it is physically impossible to set forth everything reported by these investigators, the essential facts are given. Those who desire to delve into the subject more deeply, may secure what is available from the government itself, or by application of the Deming Chamber of Commerce.

Geographic—Transportation—Markets.

The Mimbres Valley, near the center of which is Deming, is a "Bolsom" or "Pocket" plain, a geologic type of frequent occurrence in the Southwest. It lies wholly within Luna County in southwestern New Mexico, about 90 miles northwest of El Paso, Texas.

The valley, proper, is the terminus of the Mimbres river and embraces, roundly, 250,000 acres. Deming is the county seat. It is located upon the main line of the Southern Pacific railway—bisecting the valley—the Silver City branch of the Atchison, Topeka & Santa Fe railway, with through sleeper service to Chicago, and upon a branch of the El Paso and Southwestern railway. It is thus to be seen that railway facilities are excellent. Deming, being a railway center, it is the gateway for the camps in western New Mexico, among them the Burley, products of the valley to many of the largest mining Santa Rita, Pierre, Baird, Silver City and the famous Mogollon District. The latter alone draws upon the markets of Deming for over \$200,000 worth of produce annually. Geographically, Deming is the center of a vast minearalized section and is, also, a depot to a rich mining section in Chihuahua, Mexico.

Past Industry.

This district was, originally, "Cow Country". The vast acreage, together with the adjacent mountainous grazing district, offered unusual attractions for stock raising. The agricultural history of the valley began in 1908, when the first irrigating well was installed. In

1909 a Californian, former manager of the famous Cudahy ranch near Los Angeles, visited the valley, saw the one plant then in operation and immediately realized the possibilities. This gentleman, who has had many years of experience in pumping water for irrigation in California, installed a plant of 1,250 gallons capacity (per minute) and the commercial possibility of agriculture was definitely determined.

Following his example, others tried the experiment and "made good" with the result that there were in August, 1911 (date of Mr. Fuller's investigation), 150 plants in operation. There are many more at this time, the exact number undetermined and new wells are being contracted for daily.

Future Outlook.

While the Mimbres Valley may be said to be in a transitory stage, it is upon the threshold of a new era, and it is a matter of but a few years when it will rank second to none as an agricultural district.

Manufacturing has not been carried on in any form and, outside of possible smelting, will probably never form an industrial factor, though the possibilities of fruit raising will, no doubt, result in the erection of canning factories, in time.

With the practice of irrigation, the fattening of live stock will form one of the principal industries and will offer great inducements to the dairy industry, though at the present time, many thousand head of cattle from the more distant grazing territory are driven into Deming for shipment annually.

Deming.

Deming, near the center of the agricultural district of the valley and capitol of Luna County, has a population of about 3,000; National and State banks, several hotels, machine shop, ice and electrical plants, water-works system, with over 40 miles of mains, a sewer system ample for a city of 10,000; long-distance telephone connections with many cities; many first-class mercantile houses; miles of cement sidewalks and graded streets; a pumping demonstration park opposite the railroad station; numerous churches; excellent schools, including a \$50,000 high school, and a theater, at which many first-class companies, on trans-continental tours, play one-night engagements. The population is 85 per cent American. The climatic conditions of the valley make it an excellent residence city and the social advantages are good. It will be seen that it is anything but a frontier town and the excellent roads of the valley bring it within easy driving distance of the most remote sections, while for those of luxurious tastes, a 2½-hour ride by rail is all that separates them from the metropolis, El Paso.

The Chamber of Commerce, an active organization of 125 members, maintains a permanent office with salaried staff and complete equipment



Stacking Alfalfa in New Mexico.

for gathering and furnishing detailed data with reference to the valley. Inquiries should be directed to its secretary.

The sum of \$250,000 was invested in new buildings in Deming during the year 1911.

Climatological.

Tables covering this data for a number of years past are matters of record on file at Deming or procurable of the United States Weather Bureau (Climatological Summary of Southwestern New Mexico). In popular terms, the climate may be described as "semi-arid", the rainfall in the valley averaging about eight inches per annum. Winter temperature (night readings) may reach zero for a day or two during January. For a few days at a time, the ground may freeze to a depth of two or three inches. The summer temperature never exceeds a maximum of 100 degrees (day reading)—the sensible temperature, owing to the dryness of atmosphere, about twenty degrees less. Due to the same atmospheric quality and consequent rapid radiation, the nights are always cool and pleasant. The first frost occurs about October 10. The growing season is long and vegetable growth rapid. High winds (dust storms) are of occasional occurrence during the late winter months. While of no economic importance at that period, they constitute the only disagreeable phase of existence throughout all the plains country of the arid west, but are a very small factor relatively to the overwhelming preponderancy of days when mere living is a delight. Cyclones, or tornadoes, as in all the trans-Rocky mountain country—as well as blizzards—are unknown phenomena. For those desiring rest or active recreation, there is Silver City to the north—site of the United States Army Sanitarium for Consumptives, and thousands of square miles of the most glorious mountain ranges in all America with virgin opportunities for hunting, fishing and camping within a few hours' drive. Two of the most famous hot springs in America—Faywood and Mimbres Hot Springs—are within a half day's drive of Deming. It is impossible to exaggerate the climatic delights of this section—let the skeptic consult the official data referred to.

Geology—Topography and Hydrography.

The Mimbres Valley has no drainage outlet. All the water falling upon its watersheds is retained in the subterranean strata. The Mimbres river, proper, has a watershed of about 1,500 square miles—the catchment area of the entire valley embraces about 5,300 square miles. Mr. Fuller estimates the annual accretions to the vast underground supplies at 300,000 acre feet. (For the benefit of the uninitiated—an "acre foot" enough water to cover an acre one foot in depth) while Mr. Clapp states "the indications for a large underground flow are very good." The Mimbres river is a perennial stream to where it leaves the mountains to the north of the valley and enters the valley proper. There it sinks—its waters finding their way into the underground system of the alluvial and colluvial deposit which fills the valley proper. During "flood periods" the head of live water pushes its way a considerable distance into the valley, but it also is lost and sinks into the lower strata. The valley "fill" consists, first, soil from 5 to 50 feet deep, then alternate layers of clay and gravel. The "logs" of 100 wells from 150 to 200 feet in depth show gravel strata ranging from 5 to 50 feet in depth and from 2 to 10 strata within that depth. The water plane, or depth from the surface, varies from 10 to 150 feet, there being an area of probably 125,000

acres over which the pumping lift for wells of from 500 to 1,500 gallons per minute capacity will range from 30 to 85 feet. Mr. Fuller, further estimates that if 300,000 acre feet were withdrawn from the underflow (without considering the annual accretions referred to above) it would lower the water plane only 3½ inches, and places the limit of probable future demands of "profitable life" at 225,000 acre feet, annually, exclusive of loss by evaporation and ditch seepage—which items with a well upon each quarter section or less is a negligible factor.

Character of Water.

The water pumped from the Mimbres Valley is very soft and pure—containing only 60 parts of solids per 100,000 by analysis. Alkali is lacking—organic matter—from the purity of its origin, necessarily so. From the standpoint of irrigation, the absence of alkali is a factor of the utmost importance.

Soil Characteristics.

Along the river bottoms, the soil is of sandy alluvial type, but over the valley at large, of a more compact type. Underlying the top soil, which varies in depth from 5 to 50 feet, is a clay loam and this condition, together with the remarkably level character of the floor of the valley and its uniform slope towards the river channel makes the valley almost ideal from an irrigation standpoint. The heavier soil holds the moisture while the more porous top soil receives and transmits it readily to the lower stratum, affording excellent drainage and preventing "water logging." There is no evidence of black alkali and the presence of excellent crops in almost every part of the valley appears to preclude the presence of other salts in appreciable quantity. No "Soil Survey" has been made, as yet, by the Federal Government.

Crop Possibilities.

Some of the possibilities are set forth by Mr. Fuller as follows: "Some of the most remarkable possibilities from irrigation were observed in the quick response of the soil. One—the place of Dr. Conway (160 acres in cultivation) was first plowed and irrigated on April 17, 1911, and now, July 18th, 1911—in 90 days—maize stands 8 feet high, while corn and alfalfa has made an equally phenomenal growth. Eighty acres of this land is planted to red beans and will be harvested in August. The gross return from this area will be \$8,000 this fall, or in about six months. The net returns will be close to \$4,000."

Other notable ranches are those of John Hund; B. P. Shull; C. E. Hicks; S. Schwing and Messrs. Burdick & Bumpus. It would require much space to relate the success attained on these places, each of which includes from 80 to 160 acres irrigated from single wells.

The place of Mr. Bumpus showed a stand of alfalfa which had been planted about 60 days prior and would now cut over a ton of hay per acre. Judging from the crops harvested from land irrigated from plants which have been in operation for the past year or two—a conservative estimate of the average yield per acre would be as follows:

Alfalfa, 7 tons; Potatoes, 100 bushels; Red Beans, 2,000 lbs; Cane, 8 tons; Oats, 60 bushels; Milo Maize, 5 tons; Wheat, 30 bushels.

Cane can be planted following potatoes, thus securing two crops per season. I am of the opinion, however, that the soil, as characteristic of all virgin soil, is lacking in nitrogen and much better yields will be obtained after crop rotation with alfalfa.

Many other crops can be raised in the Mimbres Valley such as onions, sweet potatoes, grain, corn and garden stuff. A very great possibility exists in the raising of fruits, such as apples, peaches, nectarines, plums, pears, etc. These fruits are now raised on a small scale and are demonstrated to be of a very excellent flavor and variety. The return from horticultural crops would be large—probably four or five times that from agricultural crops.

Market Conditions.

Mr. Fuller analyzes the freight haulage records to Deming and Silver City alone, and concludes with the observation that "the gross value of the staples listed, at the then prevailing market prices, if raised in Deming would be over half million dollars annually, excluding daily shipments, amounting to \$200,000 a year, and an immense amount of canned stuff that could be prepared at Deming with the proper facilities."

Beyond these "Government" figures the Deming Chamber of Commerce estimates farming profits in the following terse resume—"30 to \$75 per acre in farm crops to \$100 to \$500 per acre in garden truck" and offers, in substantiation, sworn statements of farmers.

Land Values and Watering Cost.

Alfalfa yields three cuttings—an average of $1\frac{1}{2}$ tons per acre—the price in the field ranging from \$12 to \$17 per ton. The watering cost varies from \$12 to \$15 per acre annually. Mexican beans vary from $4\frac{1}{2}$ to $6\frac{1}{2}$ cents per pound—the watering cost varying from \$3.75 to \$5.50 per acre. Onions yield as high as 30,000 pounds to the acre and sell at from $1\frac{1}{2}$ to 2 cents per pound—the watering cost varying from \$7 to \$10 per acre.

Raw land at the present time, near town, sells for from \$60 to \$100 per acre. Land with water developed, near town, at from \$125 to \$150 per acre—but the range of investment is wide. Raw land "relinquishments" can be had at from \$2 to \$25 per acre. Deeded tracts, within five to ten miles from town, at from \$15 to \$30 per acre.

Figuring the limit of "profitable lift" at 85 feet, the cost of a farm with complete installation, will figure about as follows:

Land, \$20 per acre.

Water, \$30 (pumping plant, equipment, ditches).

Improvements, \$30 (stock, tools, etc.)

Leveling and preparing the land, \$5 to \$20.

The ultimate cost per acre for completely improved farm with a perpetual, indefeasible water-right—owned in fee and independently of anyone else. Measuring profits upon this basis, the possibilities of land in this valley can be easily calculated.

This is the opportunity the Mimbres Valley offers to homeseekers. The advantages of pumping have been thoroughly demonstrated. (See the reports of the United States Census of Irrigation for 1910 and the increase in land irrigated by pumping within the last decade.)

Each 40 or 80 acres requires a well, casing and screen; a pump and power—either gasoline, or crude oil engine, or electricity.

Deming already has a central electric power plant and several miles of transmission lines have been constructed with the intention of determining the commercial possibilities of pumping with power furnished in this manner.

A SYNOPSIS OF THE DRAINAGE PROBLEM.

The National Drainage Congress, which assembles in New Orleans April 10-13, is expected to bring the day of the 10-acre intensively cultivated farm near at hand throughout the wet land areas of the United States. The small intensively cultivated farm in the now irrigated lands of the once arid West has proved successful in every way. In Holland, Belgium, France and other continental countries, where constant and expensive fertilization is necessary, all the food crops are produced on very small farms, in the main rented or leased from the large landed proprietors.

In the wet land states of the United States, drainage will open up some 75,000,000 acres of highly productive land to purchase by thrifty farmer families, and this development is expected to result in a back-to-the-farm movement on a large scale. The independent land owning farmer is the backbone of the nation's prosperity.

In the first place, the low lands, because of the nitrogen bearing humus, are so fertile when drained that a single family can carefully cultivate only a very small area. This will mean a dense rural population, farm houses close together, many conveniences in the way of good roads, rapid transit, nearby schools and churches that isolated farm life deny.

In the next, canalization necessary for drainage will give navigable waterways from the farm to market, which is an advantage now enjoyed by the prosperous Hollander only.

The National Drainage Congress will attract many men of note from all sections of the country. In the discussions, it will be shown that drainage will put an end to malaria.

It will also be shown that proper river regulation will lower the crest of floods and freshets sufficiently to greatly reduce the cost of levee protection.

The National Drainage Congress will ask the federal government to provide the ways and means necessary for complete surveys, for the creation of a comprehensive plan of reclamation by drainage covering all the wet land states, and for the opening up of navigable drainage canals into which local drainage canals can empty. It will also ask the federal congress to enact the Newland's River Regulation bill.

It will not ask the federal government to do the local work necessary to drain any man's land.

By solving the interstate problems involved, by protecting one state from the flood waters of another state, by regulating the flow of all navigable rivers, and by making it possible for a state, a county or a land owning individual to drain low lands free from the menace of channel congestion and from freshets from other states, the federal government will clear the way for the rapid development of the 75,000,000 acres of marsh lands in the United States.

Louisiana has solved all the local problems incident to the drainage of her 10,000,000 acres of alluvial prairies, and hundreds of dredges and ditch digging and road building machines are now at work night and day. The money for this work, amounting to some \$200,000,000 ultimately, is being supplied through the sale of state protected district drainage bonds. During the sessions of the National Drainage Congress the Louisiana plan will be discussed at length and the delegates from other states will be given an opportunity to see the work underway, the reclaimed farms under cultivation, and the navigable drainage canals in use by the farmers. The bond plan, which will probably be adopted by other states, will come in for particular attention. This bond plan has just been approved in its entirety by the Louisiana Supreme Court.

The marsh land area requiring drainage in the United States is as follows:

New England States, 296,000 acres; New York, 525,000; New Jersey, 320,000; Pennsylvania, 48,000; Maryland, 192,000; Delaware, 121,000; West Virginia, 22,400; Virginia, 384,000; North Carolina, 2,645,000; South Carolina, 3,120,000; Georgia, 2,690,000; Florida, 19,800,000; Alabama, 1,480,000; Mississippi, 5,760,000; Louisiana, 10,200,000; Texas, 2,240,000; Oklahoma, 32,000; Arkansas, 5,910,000; Tennessee, 640,000; Kentucky, 441,000; Ohio, 152,500; Indiana, 800,000; Illinois, 1,485,000; Missouri, 2,440,000; Kansas, 352,000; Nebraska, 512,000; Iowa, 928,000; North Dakota, 3,100,000; South Dakota, 410,000; Minnesota, 3,830,000; Wisconsin, 2,350,000; Michigan, 2,940,000.

Send \$1.00 for The Irrigation Age, one year, and the Primer of Irrigation, paper bound, a 260-page finely illustrated work for beginners in irrigation.

THE LATEST IMPROVEMENT IN DITCHING MACHINES.

Imagine a machine capable of digging a mile of ditch a day, a ditch six feet deep and twelve feet wide, with the dirt taken from the excavation deposited on the surface on each side and tamped down so as to form a water-tight embankment. Here it is.

A most conservative estimate would be that this machine does the work of fifty scraper shovels, hauled by 100 mules, with a \$2 a day driver for each team. And then there would be left at least one-third of the original work in going over the course of the scrapers and shaping the excavation to give the finished effect afforded by one passing of the great ditching machine.

In ancient Egypt, where irrigation had its origin, the system in use before the pyramids were built is as crude and ineffective as present-day methods when compared with the possibilities involved in the immense ditching machine that has been assembled for service on the Cudahy holdings in the Imperial Valley of Mexico.

The machine was built to construct canals and laterals described in an irrigation system developed by E. E. Easton, president of the Engineers' Exploration Company of Los Angeles. It was made by the Buckeye Traction Ditcher Company of Findlay, Ohio, with E. T. Bowen of Madison, Wis., as consulting engineer in designing and construction. It was built in twenty-one days, transported from the factory to the Imperial Valley in thirteen days, and was assembled in ten days.

It weighs 100,000 pounds and covers a ground area of about 25x60 feet, and is propelled and operated by two thirty-horsepower gas engines. The engines were built in Los Angeles, and are coupled in tandem, one being held in reserve for difficult grades. The machine is all-steel construction. The most used parts are manganese steel.



The Machine at Work.



Cutting Ditch in Imperial Valley.

Aside from the general principle of rapid work with a minimum expenditure for labor, the feature is its ability to cut irrigation canals to fit exactly the dimensions of depth and width required. It is graded to a nicety and can dig a depth from one inch to eight feet, and any width from four to twelve feet.

The bulk of the weight of the machine is carried by caterpillar traction wheels of enormous size, which permits digging to absolute grade in the softest soil. The forepart of the machine carries the engines, which drives a shaft wheel, which, in turn, by a series of cogs and chains, propels the machine over the ground, and at the same time operates an immense circular digger carried at the rear. This digger is equipped with scoops with sharpened blades. It first picks up the dirt, and revolving upward, drops the earth into conveyors which carry it concurrently to both sides depositing it upon the banks of the excavation.

It is part of the plan of the owners of the 16,000 acres included in the Cudahy property to do much of the work of developing their holdings by machinery.

Powerful gas tractors will drag brushing frames to clear the area to be cultivated, the big plows to break the land, and later the disc plows and the planters that are to be used to plant 4,000 acres of long staple cotton, together with 200 acres of sea island cotton, which will constitute this spring's crop.

Mr. Daly, general manager of the Cudahy property, is investigating cotton picking machinery with a view to operating it when the big crop is ready for harvest, should his investigation convince him that the machine will do the work. A gin is to be built, and perhaps a compress.

(Continued from page 175.)

ORGANIZATION OF IRRIGATION DISTRICTS.

Under St. 1897, p. 254, as amended by St. 1911, p. 509, providing for the organization of irrigation districts, a notice of the presentation of a petition for the organization of the district which is authorized by the petitioners and which purports to be signed by some of them for all, and which is regularly published, is valid, whether the purported signatures are actually written by the petitioners or some other person by their authority. *Imperial Water Company No. 1 v. Board of Supervisors of Imperial County*. Supreme Court of California. 120 Pacific 780.

STATE REGULATION.

The legislature has power to authorize by statute the supervision and control of the appropriation and distribution of the public waters of the state by administrative officers, pursuant to adjudicated priorities; the fact that a water official may make a wrongful distribution of water in particular cases, or erroneously open a watergate to pass water for an appropriator whose right is denied by another, not being ground for holding the statutes unconstitutional. *Hamp v. State*. Supreme Court of Wyoming. 118 Pacific 653.

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THE PRIMER OF HYDRAULICS*

By FREDERICK A. SMITH, C. E.

2. Find Velocity in Cast-Iron Pipe.

The pressure in a system of water works is 25 lbs. per square inch; what will be the velocity in a 24-in. cast-iron pipe 5,000 ft. long, using the coefficient of roughness .011?

Solution—First find the constant C ; the hydraulic radius is $2 \div 4 = \frac{1}{2}$ and $\sqrt{r} = .707$, or say .71. In Table III in \sqrt{r} column opposite .7 factor $C = 123.11$; opposite .8 factor $C = 129.77$; difference 6.66; hence add .67 to 123.11 = 123.78; being factor C for $\sqrt{r} = .71$. Next substitute values in

formula: $v = \frac{C}{2} \sqrt{2.3pd \div l}$;

$$v = 123.78 \div 2 \sqrt{2.3 \times 25 \times 2 \div 5,000};$$

$$v = 61.89 \sqrt{.023};$$

$$v = 61.89 \times .151 = 9.45 \text{ ft. per second.}$$

3. Find Pressure in Cast Iron Pipe.

Problem—What pressure is necessary to produce a velocity of 6 ft. per second in a 36-in. cast-iron pipe 1 mile long, using factor $n = .012$?

Solution—Again find factor C first; $r = 3 \div 4 = .75$ and $\sqrt{.75} = .866$, say .87; in Table IV in \sqrt{r} column we find opposite .8, $C = 117.21$; opposite .9, $C = 122.68$; difference, 5.47; hence add $7 \times .547 = 3.83$ to 117.21, making $C = 121.04$.

Next apply formula No. 2 in Article xv, substituting given values:

$$p = 4 \times 5280 \times 6 \times 6 \div 2.3 \times 3 \times 121.04 \times 121.04.$$

$$p = 760320 \div 101.119 = 7.52 \text{ lbs. per square inch.}$$

4. Find Diameter of Cast-Iron Pipe.

Problem—It is proposed to supply water to a cast-iron main under a pressure of 12 lbs. per square inch. What must the diameter be of the pipe if the length of pipe 6,200 ft., the required velocity is 5 ft. per second and factor $n = .012$?

Solution—The selection of the factor C will be difficult, as the diameter of the pipe is not known and a trial factor C must be used.

In formula 3 in Article xv assume $C = 100$ —then we have:

$$d = 4 \times 6200 \times 5 \times 5 \div 2.3 \times 12 \times 100 \times 100.$$

$$d = 620000 \div 276000 = 2.246 \text{ ft.}$$

Next we must check back and see what the true factor C is for $d = 2.246$; as follows:

$r = .561$; $\sqrt{r} = .75$; looking in Table IV the factor C for $\sqrt{r} = .7 = 110.88$ and factor C for $\sqrt{r} = .8 = 117.21$, hence factor C for $\sqrt{r} = .75 = 114.04$.

If we now use 114 as the factor C in the above composition we obtain:

$$d = 620000 \div 358690 = 1.73.$$

This shows that factor C is taken too high and that 1.73 is too small. Adding now 1.73 and 2.25 gives 3.98 and divide by 2 as a mean gives very nearly a diameter of 2 ft., which must be again checked up by the true factor C ; in Table IV find C for $\sqrt{r} = .71$; for .7, $C = 110.88$; for .8, $C = 117.21$; difference 6.33, hence add .63 to 110.88, making $C = 111.51$.

Now try formula 3 again, using 111 as factor C :

$$d = 620000 \div 340060 = 1.82 \text{ ft.}$$

For general work a 2 ft. diameter pipe would be the practical solution of the problem, though a 22-inch diameter pipe (if the exact size must be had) would undoubtedly be found sufficient; to try this bear in mind commercial sizes of pipes and try between the limits established.

For another trial use $d = 22'' = 1.83$; $r = .4575$ $\sqrt{r} = .68$; $C = 103.44$ for .6 and 110.88 for .7; difference 7.44; hence add $8 \times .74 = 5.92$ to 103.44 = 109.36; trying again formula 3 using factor $C = 109$ we get: $620000 \div 327916 = 1.89$ ft.

This shows that 22 inches is not quite sufficient but is very close.

Using 23 inches = d ; this is 1.917 ft.; $r = .4792$; $\sqrt{r} = .69$; $C = 110$.

$$\text{Then } d = 620000 \div 333960 = 1.86 \text{ ft.}$$

Reducing this to inches multiply by 12 gives 22½ inches.

5. Find Length of Cast-Iron Pipe.

A 48-inch cast-iron water main leads from a reservoir, the water level of which is 100 ft. above the supply end of the pipe; what is the length of the pipe if the velocity is 6.5 ft. per second and $n = 0.12$?

Solution— $r = 1.0$ and $\sqrt{r} = 1.0$, so $C = 127.42$. Change the 100 ft. head into pressure by dividing 2.309 into 100 = 43.31 lbs. Use formula four in Article xv.

$$l = 2.3 p d C^2 \div 4 v^2.$$

$$l = 100 \times 4 \times 127.42 \times 127.42 \div 4 \times 6.5 \times 6.5.$$

$$l = 38,426 \text{ ft.}$$

6. Find the Factor C for Cast-Iron Pipe.

Problem—Find the Factor C for a 48-inch cast-iron pipe 38,426 ft. long having a head of 100 ft. and a mean velocity of flow of 6.5 ft. per second, if $n = .012$.

This problem is to check Formula 5 by using data of the preceding problem.

$$C = \frac{\sqrt{4 \times 38426 \times 6.5 \times 6.5}}{100 \times 4} = 127.42.$$

This checks correctly with Table IV.

It should be observed in the preceding problems that in determining the factor C it was taken from under the column $s = .001$. This is usually correct for pipes flowing full under pressure, as the equivalent head divided into the length give high slopes; mostly higher than .001; should, however, the pressure become so low as to produce slopes corresponding to .0004, .0002, .0001, etc., then the factor C must be selected accordingly.

Article XVI. Loss of Head by Enlargement of Channel.

1. The Principle Involved.

Whenever the form of a channel is suddenly enlarged, as indicated in figure 92, there occurs a loss of head along AB

which may be represented by the formula: $L = \left(\frac{v_1 - v_2}{2g} \right)^2$

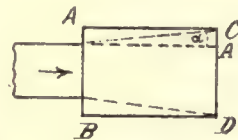


Fig. 92.

in which L is the loss of head in feet, v_1 = the velocity in feet per second in the smaller section and v_2 the velocity in the enlarged section, and $g = 32.16$. If the change from one section to the other is made gradually as indicated by the dotted lines AC and BD the loss of head is

very much reduced; if α is the angle which AC forms with

the produced line then $L = \left(\frac{v_1 - v_2}{2g} \right)^2 \sin^2 \alpha$

2. Applied Problem—A 12-inch cast-iron water pipe is enlarged to an 18 pipe; if the enlargement is made in 4 ft. and if the velocity in the 12-inch pipe is 6 ft. what is the loss of head?

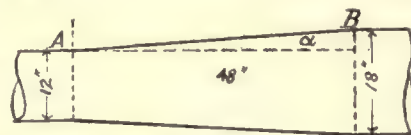


Fig. 93.

Solution—Make sketch as shown in Fig. 93 and apply formula by substituting the given quantities:

$$\frac{AB}{4} = \sqrt{48^2 + 3^2} = \sqrt{2315} =$$

$$48.11; \text{ then } \sin \alpha = \frac{3}{48.11} = .0625.$$

The velocity in the 12" section = 6 ft. = v_1 .

The velocity in the 18" section $\frac{6}{2.25} = 2.67 = v_2$.

$$\text{Then } L = \frac{(6 - 2.67)^2 \times .0625}{64.32} = .0118 \text{ ft.}$$

If the change had been made suddenly, i. e., if angle $\alpha = 90^\circ$ then L would be equal to 1.73 ft.

1. The Analysis.

To divide cylindrical channels into equivalent smaller channels of equal diameters:

Let d = diameter of large conduit.

Let x = diameter of small unit.

Let n = number of small branches.

$$\text{Then } x = \sqrt[n]{\left(\frac{v_1}{v_2} \right)^2} \text{ or}$$

$$\log x = \frac{2}{5} \left(\frac{5 \log d}{2} - \log n \right).$$

This formula may easily be worked back so as to find the size of a large cylindrical pipe equal in hydraulic capacity to a number of equal smaller ones.

Let d be the required diameter, let x be the diameter of the small pipes and n their number, then:

$$d = \sqrt[5]{(n \sqrt{x^5})^2} \text{ or}$$

$$\log d = \frac{2}{5} \left(\frac{5}{2} \log x + \log n \right)$$

2. Problem—Apply preceding formula to divide a 16-ft. diameter conduit into 3 equivalent cylindrical channels as indicated in Fig. 94:

$$\log x = \frac{2}{5} \left(\frac{5 \log 16}{2} - \log 3 \right)$$

$$\log 16 = \frac{1.204120}{5}$$

$$2 : 6.020600 = 3.010300$$

$$.477121 = \log 3$$

$$2.533179$$

2 multiply

$$\text{divide by } 5 : 5.066358 (1.013271)$$

which is the log of x , this gives 10.24 ft. as the diameter of each of the 3 smaller channels.

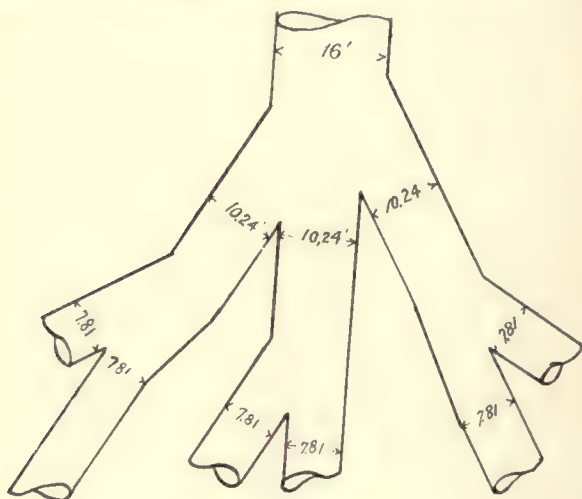


Fig. 94.

Should it be required to split each of the 3—10.24 ft. channels once more, each, say, into 2 channels and let y be the required diameter; then

$$\log y = \frac{2}{5} \left(\frac{5 \log 10.24}{2} - \log 2 \right)$$

$$\log 10.24 = \frac{1.013271}{5}$$

$$2 : 5.066355 = 2.533177$$

$$301030 = \log 2.$$

$$2.232147$$

2

$$5 : 4.464294 (.892859)$$

$$\text{Hence } \log y = .892859 = 7.814.$$

To check back find diameter of cylindrical channel which has the same hydraulic capacity as 6 channels each 7.814 ft. in diameter—use formula:

$$\log d = \frac{2}{5} \left(\frac{5}{2} \log x + \log n \right)$$

$$\log 7.814 = \frac{.892859}{5}$$

$$2 : 4.464295 (2.232147$$

$$0.778151 = \log 6$$

$$3.010298$$

2

$$5 : 6.020596 (1.204119$$

This is the log of 16 and therefore checks the work as correct.

Irrigation Accounting

Its Essentials and Advantages

Paper delivered before a recent Irrigation Congress by

N. E. WEBSTER, JR., C. P. A.

Late Consulting Accountant U. S. Reclamation Service

That accounting can and will have an appreciable effect in securing and in even insuring the success of legitimate irrigation developments may not be apparent to those who have not fully studied the matter. Yet that is the proposition which I present to this Congress as true and worthy of acceptance, and to the demonstration of which I shall devote the time given me.

It has been said that the ideal bargain is one in which both parties are gainers. Judged by this rule, a successful irrigation enterprise is one which returns its cost and an added profit to those who have developed it, and which furnishes to the farmer a dependable water supply at a price which will make it reasonably certain that he will derive an income from the land commensurate with his investment and labor.

These parties in interest include on the one hand not only those who may promote the enterprise and be in immediate charge of its development and construction, but also those who will finance it either by furnishing the capital necessary or selling its securities to others; and on the other hand, not only the agriculturists who will cultivate the reclaimed areas, but also the transportation, mercantile and manufacturing interests which will be developed to further its complete success either in advance of or following the actual farming of the soil. For this reason, the success of irrigation development is not a matter of concern to the western states alone. On the contrary, the entire country will be affected by the result and should be studiously interested in its policies and methods.

Last June I had the pleasure of being present at a dinner given by the Board of Control to the officers of the Congress. Now, after-dinner speeches as a rule, seem to be acceptable to the audiences just in proportion to the amount of wit and of optimistic forecast which the speakers bring to the gatherings. There was a curious development at this Pueblo dinner in June. I am sure all left feeling that it had been a delightful and successful occasion. And yet to an unusual degree the keynote of the several addresses was one not of optimism but of pessimistic prediction and of earnest effort to find a solution which would avoid the result the speakers feared.

As the speeches were generally reported in the press, I am violating no confidences when I tell you that these men foresaw and feared the results of unwise irrigation enterprises. Wildcatting was the expression used, and there were sober expressions of opinion that some present tendencies, if not corrected, could result only in prejudicing the mind of the general public so that it would be increasingly difficult to sell a water right under even the soundest development in all the arid country. The speakers might well have gone further and said that probably even before that time it would be al-

most impossible to finance an irrigation scheme by the sale of its securities. And that brings us to consider that in the final analysis, the persons most interested in the success of irrigation are those who buy and hold irrigation bonds and those who buy and use the water rights developed thereby. Bankers and constructors must both consider these interests if enterprises are to be successful.

And now what are the essentials to success in the development and construction of an irrigation project? I am talking broadly of the whole subject without regard to whether the projects are to be built by the nation, states, local districts or private enterprise under any of the forms of irrigation organization. These are important details, but they are details only. And in this connection I will say that I was for some years connected with the federal Reclamation Service; have been consulted and employed by Carey Act and private enterprises, and have a fairly representative acquaintance among those now engaged in irrigation development by means of all these forms of organization, so that what I have to say will be drawn from experiences with and directed towards the needs of all rather than any particular situation.

As I see it, success in irrigation development may rest on many and varying things, but in every case it requires first, control of a sufficient water supply so distributed by nature or controlled by man-built works that it can be depended upon when needed for growing crops; second, control of an area of cultivable land so located that it is practicable to apply to it the water controlled; third, engineering works so designed and constructed that they will bring the water to the land as needed; fourth, efficient and economical management in the conduct of the varied phases of the work whether promotion, financing, engineering, construction or operation.

That good accounting will wonderfully help in securing these essentials or in disclosing the lack of them is my firm belief, and my reason for accepting an invitation to address you at this time.

To determine the sufficiency of the water supply is a work for hydrographers and engineers, but the accounts should disclose the extent to which work of this kind is or is not being done, thereby enabling managers and the financing interests to call for the results of such work if done or to insist upon its being undertaken if omitted or insufficiently carried on.

A proper scheme of accounts will do a similar work as to the second and third essentials; namely, the irrigable area and the engineering design. Accounting will not pass judgment upon the effectiveness of work done in any one of these phases of the development, but it will disclose its presence or absence, and by proportion will show the degree of importance which is being given thereto by the responsible management. These three essentials involve consideration of physical conditions in the light of special technical knowledge, and while I believe all will agree that at times there have been serious lapses from the highest professional standards, yet it is a cause for congratulation that to such a large degree the engineering profession is actuated by the finest of professional principles and possessed of an excellent technical equipment.

We have said that the fourth essential is efficient and economical management in the conduct of the varied phases of the work. This is the special field for accounting. Here it is at home. It can and should be made to disclose the financial status of the enterprise and whether it is improving or growing worse. It can show what methods are economical and what are wasteful. It can be made to assist in conserving the miscellaneous small property of the concern as well as to record its larger holdings. It will offer a means of com-

paring men doing similar work and will give a basis for the consideration of the effectiveness of various kinds of machinery in construction work. It will develop construction costs which will be a guide in estimating for further similar work. It will give a basis for commercial credits to worthy undertakings, which they cannot reasonably expect without its aid. It can, in short, be made a positive help in every line of work, and when generally adopted in its best development by the irrigation enterprises most worthy of confidence, will give such enterprises an unquestionable advantage over those which are unwilling to enlist its assistance and give its results to the interested public.

There is not time now to discuss the fine points of a scheme of accounts adapted to the needs of irrigation. Moreover, the system must of necessity be devised with a special reference to the conditions of each enterprise. One will require what is unnecessary to another. Townsite development, generation of power for sale, dealing in agricultural lands, merchandising, transportation, hotel keeping, etc., are frequently associated with irrigation development, and when thus connected should have provided therefor accounting methods of the most modern and progressive types. But there are phases which are common to all irrigation development which should be carefully reflected in the accounts and for which standard forms of reports should be adopted in order to secure the best results.

I think we will get the most out of this study, if we divide irrigation costs into those for financing, for engineering, for construction, for selling, for operation and for general expenses. Cost statements should show the totals for a given period and to date for each class. But these costs should be analyzed further to show the expense upon different classes of work and upon different physical features. The percentage of engineering expense, for example, will properly be greater upon a masonry structure of involved design than upon a simple earthwork. A company may sell its water rights partly by employing a regular land selling agency and partly by its own sales organization, and should be able to know the costs and results of each method.

Moreover, there should be adopted uniform methods of stating the asset and liability accounts, particularly those which are peculiar to the business of irrigation. While the experience of other lines of industry will help in deciding such questions, there are some which must be studied probably for the first time. One such problem is that of the proper treatment of the right to the control of certain water supplies obtained by appropriation from the states, and which it is proposed to sell in the form of water rights. Should such controlled but wholly or partly undeveloped water supplies be shown in the accounts as assets? Again, when water rights are sold before the completion of a project should the estimated construction cost of these particular water rights be deducted from the scale prices and the excess carried to the credit of the loss and gain account as profit before the actual construction cost is determined, and probably when only a small fraction of the sale price has been collected? If this is new to you, it probably sounds academic and theoretical, but upon the answer to this latter question rests the determination of whether such unliquidated, and to a degree problematic profits, are subject to the federal corporation tax, and when. Here, as often, theory goes ahead and points the way to practice.

You will note that I am contending for a standardization of accounts, as well as for the accounting per se. There is a reason for this, and one which should appeal strongly to those who are directing irrigation enterprises. It is not an

accident that railroad accounts have been reduced to a standard so that each company keeps accounts essentially similar to those kept by all other companies. It did not happen that bank statements came to be presented in the same form the country over. It was not by chance that insurance companies came to use identical methods. Nor as some may think, were these results brought about solely by the imposition of governmental control. It is true that national banks were required to report in a standard way, but the state and private banks adopted the same forms, not from necessity, but for self interest. Railroad accounts have been developed along identical lines, not because of governmental control, which is a very recent development in this matter of accounting, but because the accounting officers of the railroads have been working together, each contributing what he had found valuable and giving this to the others through the medium of their national association. Before there was any public service corporation legislation, the accounts of gas, electric light, water and traction companies had grown to be so nearly uniform, that many companies made but little change in methods in complying with the requirements of the public utility laws when enacted.

And there was a reason for this uniformity. By it each company had the opportunity of comparing or contrasting the effectiveness of its own methods with the results obtained by others, all tending to the highest efficiency and economy. This reason should be just as potent in the irrigation industry. What are the best and cheapest forms of organization and methods of work? Who knows. Ten years ago there was probably not a single contracting organization in the country that was attempting to analyze its construction costs. When a job was completed the contractor knew how much he had gained or lost; while it was going on he guessed conditions as he had originally in bidding on the work. Today, contractors are endeavoring to ascertain costs as the work progresses so that costly methods may be abandoned for more economical ones, and the final balance brought on the right side of the loss and gain account. But someone says, "We let all our work by contract and do no actual construction ourselves." Very well, but what of the future costs of maintenance? Are they being fixed upon a basis of accurate information or of hopeful guesses? I venture the surmise that 90 per cent of the maintenance charges have been made upon no better basis than a sheer guess with an eye always to what the other fellow charges. Ten years of good accounting should give us a vastly better method of forecasting maintenance charges upon different classes of work and under varying conditions.

But there was another reason why these older lines of industry developed similar accounts and adopted standard forms of reports. They found that thereby they could more readily market their securities when additional capital was required. A railroad or public utility which should go into the money market for a loan or to sell an issue of bonds, and which was unable or unwilling to exhibit balance sheets, statements of operating expenses and fixed charges, of gross and net earnings and gross and net income, would probably conclude that the money market was very tight. But your situation is likely to be about that unless you adopt the methods which obtain in these other lines of business. I have seen a letter from an eastern broker to an irrigation company, whose securities he was attempting to place, in which he asked the company's officers to stop writing in terms of glittering generalities about their scheme but to send him statements of figures, adding: "Nothing else goes in this town."

Reclamation Notes

CALIFORNIA.

The Balfour-Guthrie Company of Stockton has purchased 5,000 acres of land near Byron in Contra Costa county, and will divide the land into a new irrigation district. According to reports, plans for the formation of the district are well under way. The proposed district will irrigate 11,000 acres of land. Farmers are co-operating in the project and the boundaries of the district may be extended to include additional lands. Water will be taken from Indian slough for irrigation purposes.

The settlers and land owners of Honey Lake Valley held a mass meeting March 2 for the purpose of taking steps to place before the National Government development of an irrigation system for the land surrounding Honey Lake. There are 168,000 acres of irrigable land, a large part of which has been taken up by the farmers. According to the plan proposed Eagle Lake will be tapped by means of a tunnel.

Stratford farmers have formed a company which will take care of the irrigation of the ranches of the members. Articles of incorporation have been filed by the Mercedes Pumping Company. The principal place of business will be Stratford. The capital stock of the company is \$5,000, divided into 5,000 shares of \$1 each. It is the purpose of the company to bore artesian wells, run ditches and perform such other work as is usually performed by irrigation companies.

An irrigation district embracing 128,440 acres has been formed by the farmers of Big and Little Shasta Valleys. Water will be brought from Klamath River through a twenty-mile canal and distributed throughout the valley with many miles of laterals.

The board of directors of the Modesto irrigation district have called a special election to vote an assessment of \$20,300 to complete work on the upper canal and to pay the running expenses of the district until August 1. The money will not be collected until the taxes are paid.

The Sacramento Valley Irrigation Company has purchased 6,500 acres of land known as the Edgar Mills ranch, located about three miles west of Maxwell, for \$200,000.

A big land sale involving the sale of 5,500 acres of the Sharon estate just over the line in Madera county, and 8,500 acres owned by other parties lying adjacent to it, has been consummated. The purchaser is the Co-Operative Land & Trust Company of San Francisco, with a branch office at Merced. The land will be divided into small farms. Water for irrigation is secured by pumping. The lift is short and the supply of water apparently inexhaustible. The main line of the Southern Pacific Railroad cuts the new colony in half. A township named "Fairmead" has been plotted near the center of the colony.

The Superior Land & Water Company of Woodford is installing a pumping plant which will supply water to 2,200 acres. The pumps are to be in place by the last of April and planting will begin on a large part of the land in May and June.

Contract for the construction of sections 3 and 5 of the main canal of the South San Joaquin Irrigation District has been awarded to T. K. Beard of Modesto. His bid was \$507,365. The contract for section 4, a large flume, was let to the Pacific Construction Company on its bid of \$53,715. Contracts have now been let for all the work needed to bring the water to the eastern

boundary of the district. Work must be completed by April 1, 1913.

A plan has been formulated by the owners of a tract of land situated between the Alameda county line and Tracy, which, if executed, will place 15,000 acres of land under irrigation. To raise the money necessary to make the project possible, the property will be bonded. An assessment of 5 cents per acre is to be levied to foot the preliminary expense of organization. Water will be taken from Old River to the McLaughlin place and thence over the entire district.

COLORADO.

The Huerfano Valley Irrigation Company, which has been working for the past four years on an enormous irrigation project, embracing 50,000 acres in southwestern Pueblo county, have filed a map of the Green Mountain Reservoir with the Pueblo county clerk. The map was filed by A. P. Sickman, of Denver, who is interested in the project. The Green Mountain Reservoir will have a capacity of 2,583,011,991 cubic feet. This is sufficient water, according to irrigation engineers, to water 75,000 acres of land. The dam when completed will be 294 feet high. Water will be taken from Big Graneros Creek, Little Graneros Creek, Greenhorn, and others.

The Ignacio irrigation project, which has been held up six years because of alleged wild-catting methods, is to be reopened by the state land board. The district was granted to the Colorado Land & Water Company in 1906 and at an opening in June, 1909, ten thousand acres were contracted for. Forty thousand dollars were paid down in cash. It had been advertised that the land would grow most anything desired—sugar beets and tokay grapes. The irrigation company blamed the erroneous advertising upon a colonization company with whom it contracted to secure settlers. Purchasers of the land complained to the land board that the land was not up to the advertisements. It ordered the company to refund the money to those settlers who wished to withdraw. The contract of the irrigation company has been held void by the board and will now be reopened to bids.

The Pueblo-Rocky Ford Irrigation Company has been sued in the District Court by the Phillips Construction Company and William O'Gara for \$62,183.44, alleged to be due on a 182,150 contract for the construction of a dam across the Cucharas River. The construction company alleges that the irrigation company failed to file its annual report for 1911 with the secretary of state, and for that reason is liable for the debts of the company.

The Secretary of the Interior has awarded contract to Maney Bros. & Company of Boise, Idaho, for the construction of twelve miles of the west canal, Uncompahgre Valley project, in the vicinity of Montrose. The work involves the excavation of about 210,000 cubic yards of material in open cut and 1,750 linear feet of tunnel. The price at which the work was awarded under the proposal of the successful bidder is \$78,363.

A clear title was given the \$5,100,000 bond issue of the Greeley-Poudre irrigation district recently when two suits attacking its validity were dismissed in the Supreme Court. Those attacking the validity of the project were stockholders in ditches of the Greeley-Poudre district. A settlement has been reached with them which removes the only cloud upon the finances of the district.

More than 40,000 acres of land lying between Denver and Brandon are to be reclaimed by pumping. F. A. Otten, of Nebraska, has let a contract for an irrigation pump to be installed on his land, 1,120 acres, lying one-half mile east of the town of Brandon and 60 miles east of Denver. The entire acreage will be irrigated by the one pump, which will be installed at a cost of \$22,500.

The Chicosa Basin Reservoir Ditch & Land Company of Pueblo has filed articles of incorporation with the county clerk. The purpose of the company is to

irrigate a tract of land lying south of the city of Pueblo and disposing of it to homeseekers. The capital stock of the company is placed at \$50,000. W. L. Williams, J. C. Hedgecock and A. E. Frazier, all of Pueblo, are the incorporators of the new company.

An irrigation district embracing 200,000 acres of land is being formed by farmers in Saguache county. Water will be taken from the Rio Grande River about 15 miles east of Del Norte and carried north about 20 miles and east about 10 miles to the tract to be watered. A reservoir site will be situated on the upper Rio Grande at Antelope Park, with a capacity of 262,000 acre feet. The district will also acquire water from Carnero, Saguache and Lagarita creeks.

Work will be begun in the near future on the Holly-Granada irrigation project, embracing 52,500 acres of rich land lying adjacent to the towns of Holly and Granada and south and east of the town of Lamar. Water will be taken from Rule creek which runs into the Purgatoire.

Arthur Day, receiver for the Denver Reservoir & Irrigation Company, has been authorized to issue a ninety-day promissory note, dated March 1, to Edmond Seymour & Company of New York, for a loan of \$25,000, with which to pay necessary expenses and conserve its property.

The Henrylyn irrigation district, embracing 90,000 acres of land in the vicinity of Hudson, in southeastern Weld county, has made a record in speedy irrigation construction work, and will bring 20,000 acres of its land under cultivation this season, although the project was only started in May, 1910.

Construction of an irrigation system, covering 100,000 acres in San Miguel and Montrose counties, to be watered principally from the San Miguel River, will be started immediately. It is a project that has been held up by conflicting claims to water-rights for years. The state land board has now entered a contract with Duncan Chisholm of Colorado Springs and General Buckley Wells of Telluride, over the protests of four or five smaller irrigation concerns, for putting through the big undertaking. With these two gentlemen is also associated Chaloner Schley of Colorado Springs, a wealthy former New Yorker, and it is reported that they have at their command a supply of English capital. It is estimated that the project will cost \$5,000,000. The terms to which the contracting company will adhere are: Sale of water to 90,000 acres at \$50 an acre; water to remaining 10,000 acres in east Paradox valley, at \$65 an acre; twenty years instead of the customary ten for payment of water; first payment by settler not due until after he has secured a crop.

The DeWeese-Dye Ditch and Reservoir Company of Canon City have elected a new board of directors, as follows: J. W. Dunlap, Dr. Allan Bell; H. J. Black, N. B. King, and W. B. Rowland. Improvements will be made on the ditches of this company so that they will be in first-class condition for the coming irrigation season. Concrete headgates will be installed at the intake of all of the principal laterals.

At a meeting of the land owners under the Municipal irrigation project held in Pueblo March 8th, a bond issue for \$2,500,000 was authorized. The bonds will be 20-year 6 per cent irrigation bonds under the new Colorado law which provides for municipal irrigation projects and authorizes the collection of assessments against the lands for the payment of principal and interest of bonds. The company proposes to reclaim about 50,000 acres and the assessment will be about \$50 per acre. The water rights of the Alamo Irrigation Company, a Denver promotion, are to be purchased with a part of the money received through the sale of the bonds. Piney creek, on the western slope of the mountains, will be tapped and the water brought to the eastern slope. It will be brought

(Continued on page 187.)

FARMER AND MANUFACTURER FIGHT THE SAME BATTLES.

Setting Up a Quality Standard Means Keeping at It Through Many Discouragements.

The farmer who is getting the utmost out of his farm today is working along the lines to highest quality, as well as greatest quantity.

Why? Because quality of product pays as well as quantity. It pays better.

The greatest per cents in farm profits are being reaped by the men who grow the best grain—the best cattle—who produce the best butter and the best vegetables.

They are the men who show us what perfect grades mean. They set up the standard which others must follow if they would succeed. They get more than money profit out of it—they are rewarded with the soul-satisfying pleasure that comes only from doing things well.

More and more our farmers are coming to realize this. Hence, the constantly widening interest in seed selection—in the scientific preparation of seed bed—in modern methods of thorough cultivation—in a word, everything that enables Mother Nature to put all the quality in her products that rightly belong to them.

More than eight million people wear "Ball-Band" rubber and woolen footwear. Many of our readers are among the millions who have worn "Ball-Band" for many years. Multitudes are added to this host every year. But the explanation of this amazing army of more than eight million customers is the fact that the old customers stick.

Now why do they remain loyal to "Ball-Band"? People don't come back a second time for an article that disappoints them. Eight million people are not deceived year after year by goods that lack merit.

The only answer is wearing quality—good, old-fashioned wearing quality, that causes the buyer to remember the name, and to insist on having the same kind the next time he buys.

This enormous demand for "Ball-Band" represents a steady growth of nearly a quarter of a century, from small beginnings.

The business of the Mishawaka Woolen Manufacturing Company originated in the manufacture of all-knit wool boots and socks. This explains the "Woolen" in the name of the company, though rubber footwear is now by far the larger part of the output. As the business grew, the company could neither obtain the quantity nor the quality of rubber goods which had to be supplied with its woolen footwear.

The company, therefore, went into the manufacture of its own rubber footwear. The result was "Ball-Band" rubbers.

Competition was just as keen when "Ball-Band" was first marketed as it is now.

Nothing is more interesting than following the process of a rubber boot from the crude rubber to the finished "Ball-Band," which keeps more than 16,000,000 feet warm, dry and comfortable.

The rubber "biscuits" are put through crushing and

grinding mills, thoroughly washed and cleansed. It is in the form of big sheets at this stage.

After being thoroughly dried, this rubber is taken to another department where the compound is made, which not only makes the rubber workable, but gives it additional toughness and resisting quality. It makes it possible for the footwear to be vulcanized.

Powerful machines press this compound of rubber into the meshes of cloth used in the linings, and thus strength is added to strength; the different parts are cut out and each boot or shoe is made by a skilled workman, who builds it entire on special aluminum lasts. After the shoes are made, they are put into a dry kiln, where they are vulcanized at a temperature of over 200 degrees. The next morning they are brought out and finished, thoroughly inspected and then packed ready for the market.

In a year's manufacture of "Ball-Band" goods, 1,252 carloads of raw material, supplies, etc., were used. This material, if put into one continuous train, forming a hollow square, would enclose more than 3,600 acres with a solid wall of fully loaded freight cars.

It required 5,000,000 square yards of sheetings, cotton duck, cashmerette, wool linings, etc., to make these goods—enough cloth to cover 1,033 acres completely.

One and a quarter billion yards of yarn was spun for knit boots, lumbermen's socks, etc.—more than enough to form three strands from the earth to the moon.

The pioneer quality farmer has had his battles to fight. At times it has looked as if the returns were not paying him for his time, his labor and his discouragements. But he has won. He is winning.

The markets of the world welcome him. His stock, his butter, his chickens, his eggs, are virtually trademarked with his own name and he gets his own price for them.

And you will observe that the farmers who are giving quality are demanding quality in return.

These are the farmers who are buying the best grades of clothing, the best grades of footwear—the best of everything. They know that quality is the most profitable thing in which a man can invest. It pays to buy quality just as it pays to sell it.

The manufacturers who meet the quality demand certainly have the support of all thinking farmers, whatever anyone may say to the contrary.

Advertisements appearing year after year in the best class of agricultural publications prove this. Look these advertisements over. They have a lesson for everybody who classes all farmers as buyers in the cheap, poor-grade markets.

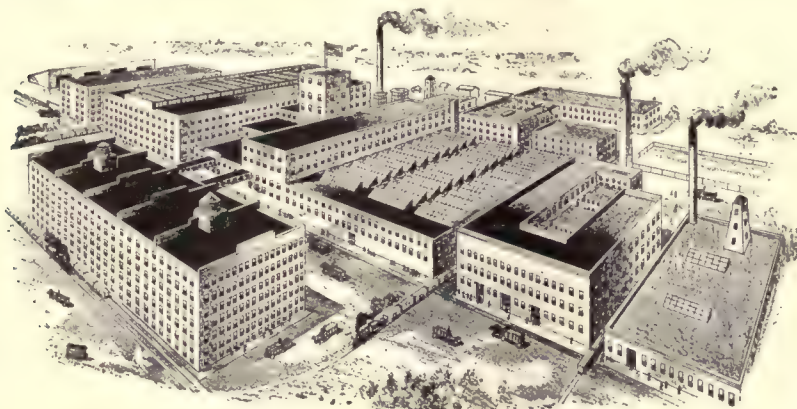
After the government dissolves a few more trusts as being law-breakers and contrary to law, some banks may be anxious and willing to invest in substantial irrigation bonds instead of wild-cat industrials.

DO IT NOW.

Remit \$2.50 for the "Primer of Hydraulics," cloth bound; it is ready now.

The investigation of the surface waters of the United States by the Geological Survey has accumulated a store of information concerning the amounts of inorganic material contained in the river waters of the country. A part of this information is contained in Bulletin 479, "The Geochemical Interpretation of Water Analyses," by Chase Palmer, just published by the Geological Survey. This bulletin may be obtained on application to the Director of the Survey at Washington, D. C.

The Irrigation Age is the representative paper for irrigation and drainage and should be in the hands of everyone interested in these two great subjects.



Plant of the Mishawaka Woolen Manufacturing Company.

(Continued from page 185.)

down the Arkansas river with other water from the eastern slope and stored in reservoirs, from whence it will be conveyed by canals to the lands to be irrigated. The land to be irrigated lies southwest of Pueblo and includes most of the Boggs Flat district.

IDAHO

A 10,000-horse power hydro-electric plant will be built on the Payette river, near Boise, for C. L. Tallmadge, of New York City. Plans and specifications are now being prepared by the W. H. Rosecrans Engineering Company, 30 North La Salle street, Chicago, Ill., who are the consulting engineers. Bids will be received in about thirty days.

The Emmett Irrigation Company of Emmett will replace all wooden structures on their system with modern metal flumes, siphons, etc. Plans and specifications are now being prepared by the W. H. Rosecrans Engineering Company of Chicago.

Residents of Bonners Ferry, Copeland and Porthill, in the extreme northern part of Idaho, and farmers and business men of Crestin, B. C., held a meeting recently at which plans to irrigate 80,000 acres of land in Idaho and the province of British Columbia were discussed. Resolutions were adopted calling upon the premier and ministers of agriculture, lands and public works of the province and others interested to investigate the plan, also to appoint a competent engineer or commission to report upon its feasibility and the best methods to be adopted for the reclamation of this acreage.

Contract has been awarded by the Secretary of the Interior to the American Hoist & Derrick Company of St. Paul, Minn., for furnishing four electric hoists and derricks for use in the work of construction on the Arrowrock dam, Boise irrigation project. The price for this equipment is \$14,836.91.

MONTANA.

The government will hold an important sale of lots April 18, on three townsites on the Huntley project. These lots are located in the towns of Ballantine, Worden and Pompey's Pillar, and the majority are in the business portion of the towns. Under the ruling of the department, all purchases of lots on the day of the sale will be given a term of five years to complete payment. These townsites are surrounded by a thickly settled and compact farming community, the average farm holding being 40 acres. Each of these towns is on the main line railway.

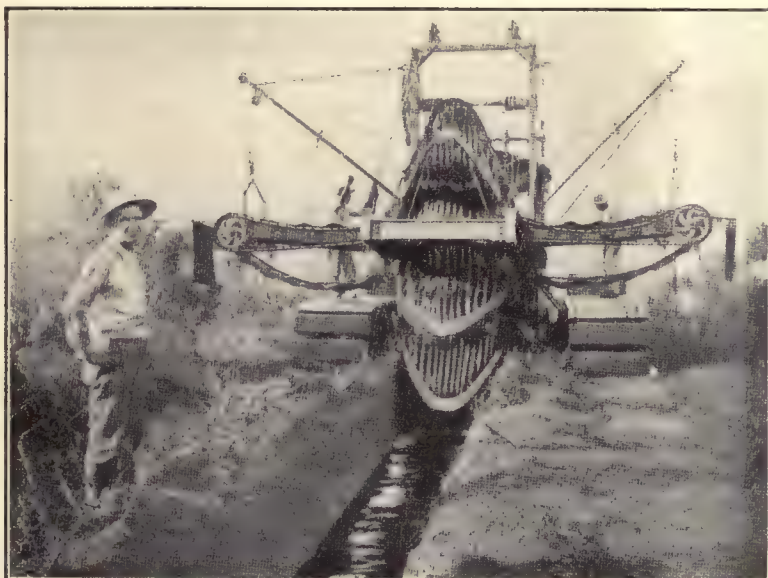
Articles of incorporation for the Valier-Montana Land & Water Company have been filed with the secretary of state. The purpose of this company is to complete the work commenced by the Conrad Land & Irrigation Company some years ago. The capital stock of the new company is placed at \$3,000,000. The Conrad company was only capitalized at \$250,000, and the project was too large for that amount of money to handle properly. The directors of the new company are Patrick Kelley, A. E. Schwingel, W. S. Frary, Omar J. Malcolm, J. A. McDonough, J. McCambridge and W. Olsen, all of Valier, each of whom has paid in one share of common stock of the value of \$100.

Philo Hansen, Joseph Dawes, E. A. MacPherson, M. Genzenberger and Al Paynter, all of Butte, who are interested in an irrigation project near South Plains, are making arrangements for spring work. The big irrigation ditch out of Combest creek will be continued and other improvements made for the benefit of the orchard tracts.

An experimental irrigation well is being sunk on the farm of V. A. Wolcott two miles north of Plains. The well is 12 feet square and will be put down to a depth to insure plenty of water for irrigating a 40-acre tract. The result of this enterprise is being watched by many who purchased tracts in the valley last fall. If it proves a success many others will put down wells.

Get a Buckeye Open Ditcher and Cut Your Excavation Cost

IT HAS been proven time and again that the **Buckeye Open Traction Ditcher** will cut down the cost of excavation work from fifty to seventy-five per cent when used in connection with the reclamation of land, irrigation projects or extensive road building.



Reduces Labor Bills

The **Buckeye Ditcher** reduces labor bills to almost nothing and takes the place of from 50 to 150 men with spades and shovels, and does the work quicker and better, digging a ditch of uniform size.

Digs Ditch with Sloping Bank

The **Buckeye Ditcher** is the first machine ever built that will dig a ditch with sloping bank at a continuous cut. It is built in many different sizes, cutting from 2½ to 12 foot top, with any slope desired.

Works on Very Soft Ground

The **Buckeye Ditcher** has made an excavation with a 4½ foot top and a 2 foot bottom, at a depth of 3½ feet at the rate of 6 lineal feet a minute, while being operated in wet or soft ground. The apron tractions make it possible to use the machine on land that will not sustain the weight of a team of horses and an empty wagon.

Write Today for Catalogue No. 26

if you want to learn how to reduce your cost of excavation work and turn hundreds of acres of waste land into dollars.

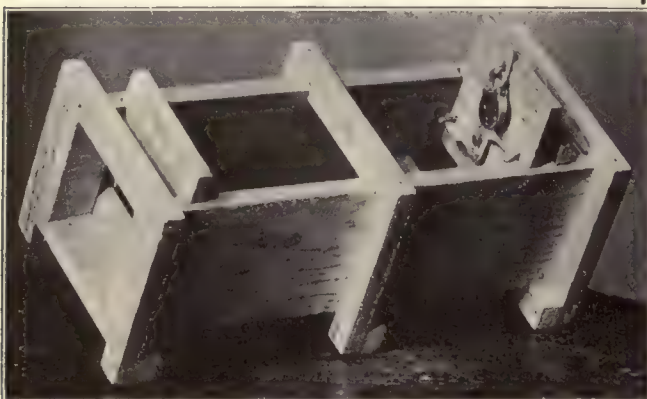
The Buckeye Traction Ditcher Co.

FINDLAY, OHIO

Combination Headgate and Measuring Device.

The belief that Capital and Labor, that Employer and Employee, that Manufacturer and Consumer, that Home Office and Agent, that the House and the Salesman on the road should get together and stay together in a closer and more intelligent manner than ever before, and that all "Big Business" of the future should mean "Big Business" for all concerned, and not merely for the company itself, was the principle upon which this company was founded; and a summary of the results achieved in its short existence up to the present will show how well founded was that belief.

Loyalty to employer is a phrase familiar to all; but loyalty to the employee, while not so much in vogue, is just as essential to rapid progress along substantial lines.



On August 6th, 1911, the IRRIGATORS SUPPLY CO. was granted, by the great commonwealth of Montana, a charter with a capital stock of \$10,000. Loyalty to its agents and employees made it imperative to increase that capital stock to \$50,000, which was done on October 3d. And today, January 1st, 1912, we are arranging for a subsidiary company in the state of Washington, to take care of our business in that state. In two short months this same "loyalty to agents" has given us, in the state of Montana, four Agency Directors, as good traveling salesmen as ever slung a grip. They are A1, high-class gentlemen, prosperous and happy; and, through their untiring work and honest and intelligent manner of presenting our proposition, we now have thirty agents, selected from Montana's best business men, who, in turn, are preaching a uniform and equitable system of measuring water by the use of our COMBINATION HEADGATE AND MEASURING DEVICE.

At times we have felt inclined to the belief that the demand for the device itself was the cause of our rapid growth; but, with any other system or method than loyalty to the employee, we could not have covered the territory with such a sales force in so short a time, no matter what the demand or what the article we had to sell. So we are going to continue our plan with this as our slogan, "Loyalty to the Employee," and make each man a part of the great machine for selling our COMBINATION HEADGATE AND MEASURING DEVICE.

Although our device is approved by the best authorities of the state; although it has the endorsement of U. S. Senators and U. S. Surveyors, general judges and engineers; even though the judges of the courts recommend it, and some even require its use; and though it has the praise of our 800 Montana farmers who are using it, we find loyalty to the employee the most important factor in distribution yet discovered and recommend it to all employers, whether of one man or one million men.

If you are interested in, or troubled about, the measurement of water; or if this subject is causing trouble in your district, and you wish to be instrumental in abolishing the trouble, write, wire or 'phone the

U. S. Irrigators' Supply Co.

Montana Block, Missoula, Montana

Articles of incorporation have been filed in Indianapolis, Ind., by the Tongue River Irrigation Company, with headquarters in Indianapolis. The capital stock of the company is placed at \$130,000. It is stated that the new company is merely a reorganization of an old company organized for the purpose of holding lands in Custer county, Montana. All of the incorporators live in Indianapolis. Among them are William Holton Dye and Robert I. Blakeman.

NEW MEXICO.

A complete irrigation system to cost approximately \$40,000 is planned by the Muddy Valley Irrigation Company of Las Vegas, operating in the Muddy and Moapa valley. Included in the plans of the company is the construction of two electric power plants to be operated by the water power developed by the improved system. About 10,000 acres will be irrigated by the company by means of two canals, the combined length of which is about 30 miles.

Pumping for water on a large scale will begin in the Albuquerque valley about April 1. Telegraphic approval of the tentative contract entered into several weeks ago between the farmers and the Albuquerque Gas, Electric Light & Power Company has been received at Albuquerque by E. C. Butler, manager of the company at that point. Construction work on the power lines will be commenced at once and rushed to completion. The line south of Albuquerque will be constructed at a cost of approximately \$10,000. Provided the farmers meet with success south of Albuquerque, lines will be built north and west of that city.

The Red River Company of Bell Ranch, San Miguel county, has been granted an application for water rights for a 100,000-acre irrigation project. The land involved is located on the Montoya Land Grant.

The U. S. Reclamation Service has a large force of men at work giving the lateral system of the Carlsbad project a thorough overhauling. Every lateral is being repaired and put in perfect condition.

Irrigators, Attention!

WE have a district of independent water-rights. No weeds from a community ditch, no waiting your turn for water, no chance for water-thieves to steal your water. On the other hand, our farmers have water whenever they want it. It is the purest water in America. The original water-right costs but \$20 or \$30 per acre, and is based on the most dependable supply of water for irrigation on the globe—namely, on the great underflow of the Mimbres Valley, which has a watershed of 1,400 square miles and a pumping area of only 125,000 acres at the most. The lift for water varies from 15 to 100 feet, and with improved devices for raising water, every well-informed man knows that where abundant water can be secured at such a lift, the pumping plant makes the surest, cheapest and most dependable water-right in the world. We have it here. Also low values. It is just the sunniest and most beautiful valley in New Mexico, and just the place to build a cozy country home that will make you and your family independent for all time to come. Now is the time to get in on the ground floor. Less than five per cent of the irrigable area is reclaimed. This, of course, means rock-bottom prices. Write Secretary, Deming Chamber of Commerce, Deming, N. M., for a booklet describing the best irrigation proposition in America. Don't wait. Write now.

Please mention name of this publication.

OREGON.

It is reported that eastern capital will revive the Sturgis ditch, one of the largest reclamation projects proposed in the eastern part of Oregon. The plan is to take water from the Umatilla river, 20 miles east of Pendleton, and convey it through a ditch of from 30 to 40 miles in length to the heads of North and South Cold Springs canyon, and thence to the government's Gold Springs reservoir, which now furnishes water for the Umatilla project. By using the flood waters it is estimated that 100,000 acres can be irrigated.

The full amount of \$150,000 has been subscribed by the bondholders of the Central Oregon Irrigation company, formerly the Deschutes Irrigation and Power Company, to the stock of the Deschutes Contract Company, which will complete the irrigation scheme in central Oregon in accordance with the new contract which the company has made with the state. Work on the project was commenced several years ago but the company was unable to finish the project and a receiver was appointed. The project will now be rushed to completion.

John and Louis Gerber of Sacramento, Cal., are the promoters of an enterprise to irrigate 187,000 acres of land in southeastern Oregon. The plan is to build an immense storage reservoir of the waters of a watershed in the Cascade mountains. The reservoir site is known as the Horse Fly ranch and has a natural outlet down Miller Creek canyon which has a fall of 125 feet to the mile in three miles.

The La Grande Irrigation Company of La Grande have filed articles of incorporation and will reclaim 10,000 acres of semi-arid land east of that city. Among the stockholders are L. A. Lewis of Portland; M. H. Davis, Boise, Idaho; J. E. McKinney, F. L. Myers and J. E. Reynolds, all of La Grande.

TEXAS.

The Espeyo Land & Irrigation Company of San Antonio is preparing to place a large tract of onion land on the market in the near future. Five hundred acres of Rio Grande valley lands, located twelve miles below Laredo, are being grubbed, and it is expected to have them in readiness for the fall planting. In addition to this tract 250 more acres are to be improved and will be ready for cultivation at a later period. The company owns 18,500 acres of land along and extending back from the Rio Grande river below Laredo. Two large pumping plants are to be installed for irrigation purposes and the land will be improved and divided into smaller tracts for marketing as rapidly as possible.

W. J. Riddell, R. R. McCutcheon and B. F. Kauffman, all of Des Moines, Iowa, have secured 18,000 acres of land in Texas and have formed the Plainview Irrigated Land Company. The capital stock of the company is placed at \$100,000. The land is located near Plainview in what is known as the shallow water belt. The firm proposes to establish a demonstration farm which will be in charge of a representative from the United States

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IN

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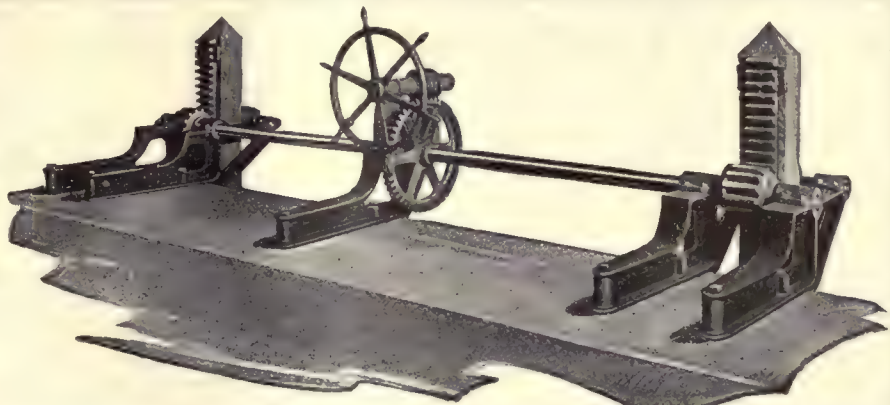
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Department of Agriculture. The farm will include 160 acres of alfalfa and 40 acres of diversified products.

The Kingsville Power Company of Kingsville is installing three motor driven air compressor pumps, all within a radius of three miles of that city. One of the pumps will be located on the 500-acre farm of B. F. Yoakum, and is placed as an experiment to determine whether or not this is the most economical means of lifting the water from wells. The other two wells are on the property of the Kleberg Town and Improvement Company, about three miles from Kingsville.

The Leonceita ranch, located midway between Fort Worth and Alpine, and embracing 42,000 acres of land, will be placed under irrigation at once. The project is being financed by the Commerce Trust Company of Kansas City, Mo., and will cost more than \$1,000,000. The land will be placed on the market within six months. A large dam will be constructed at the foot of a deep canyon and the water will back up for many miles with an average depth of 30 feet. The reservoir will be fed by five creeks and a number of small springs.

Five thousand acres of rich land lying adjacent to Corpus Christi will be irrigated by water impounded from Tule lake, according to the reported statement of Capt. W. A. Fitch, of San Antonio, who is interested in the project. The captain states that the plans are well under way and that construction work will probably commence

before July 1. Tule lake reservoir has been estimated to be capable of impounding 786,695,677 gallons of storm waters within a year, and the seepage is less than 3 per cent.

The Medina Townsite Company of San Antonio, with a paid-up capital stock of \$25,000, has been chartered in the Department of State. The object of the company is to improve and sell townsites in the state, specifying no definite localities. The shares are \$100.

The Melvine Land & Irrigation Company of San Antonio has filed its charter with the department of state. Capital stock, \$50,000. Incorporators: W. R. King, F. G. Hillje and T. F. Mangum, all of San Antonio.

J. M. Brooks, of Boston, Mass., will spend more than \$300,000 in placing 28,000 acres of land under irrigation near Fort Stockton. Mr. Brooks recently purchased the land from Pecos Valley ranchmen in three separate tracts.

Work is progressing rapidly on the proposed Cotulla irrigation district, which will bring 50,000 acres of land under irrigation.

Articles of incorporation have been filed by the Markham Irrigation Company. Capital stock, \$50,000. Principal place of business, Markham. Incorporators: Hudson Pellis, Levering Moore and Jesse Andrews, all of Markham.

UTAH.

The San Juan Irrigation Company of Grayson has filed articles of incorporation with the secretary of state. The capital stock of the company is placed at \$100,000, divided into shares of \$10 each.

An important decision has been rendered in the contempt proceedings recently tried in the case of the Spanish Fork Irrigation Company vs. Leven Simons, et al., the original case having been tried and judgment entered in 1899. In this case Leven Simons, H. B. Ricks and James Ballard, three of the defendants in the original case, were cited for contempt in violating the original decree, which involves the water of Spanish Fork river. The decision absolves the three men from any intentional contempt in using the water contrary to the decision, but assesses all the costs against the three men.

A number of prominent irrigationists of the state of Utah are planning to bring under cultivation about 150,000 acres of land, about 20,000 acres of which lie in Weber and Davis counties. In a recent statement, Mr. David O. McKay, of Ogden, who has been active in the work, said the cost of building reservoirs for the conservation of the surplus or flood waters from Weber and Provo rivers would be \$5,000,000. Mr. McKay is of the opinion that two reservoirs should be built; one to be known as the north project and located near Coalville in Summit county; the other to be known as the south project and located near Charleston, in Wasatch

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county. Definite plans have not yet been worked out but it has been virtually decided to take up the northern project first.

Reclamation of 168,000 acres of desert land along the west bank of the Green river at a cost \$6,000,000 is forecast in an application to the state land board for the permanent segregation of the tract under the Carey Act. The applicant, an irrigation company, will have to build 400 miles of canals to irrigate the land. The name of the company has not yet been made public.

WASHINGTON.

F. C. Kelsey, chief engineer of the Kittitas reclamation district in central Washington, states in a report to the directors that the main line canal and branches will cost \$3,802,328, or an average of \$41.80 an acre for 91,000 acres. The cost of storage in Naches lake is estimated at \$8.50 an acre, which has been promised to the district by the Secretary of the Interior. The directors have added \$500,000 to the total estimated cost to cover laterals, rights-of-way and other expenses, bringing the grand total to \$5,000,000. The district was created last September. It is thought that the canal will be completed in about 18 months.

George T. Crane of Spokane and his associates, including Carl B. Crane and Alfred DeVeto, the last named a resident of Boston, will install a pumping plant costing \$20,000 on a 350-acre commercial apple orchard near Bridgeport, Wash., on the Columbia river. Two hundred acres will be planted this spring. The company is capitalized for \$125,000. None of this land will be put on the market but the entire acreage will be operated as a commercial orchard by the projectors.

Eighme & Eighme of Riverside will irrigate 1,000 acres of land near that town next summer. Water will be taken from Blue lake, which cover 70 acres and is only

A. W. SLOSS,
Manager

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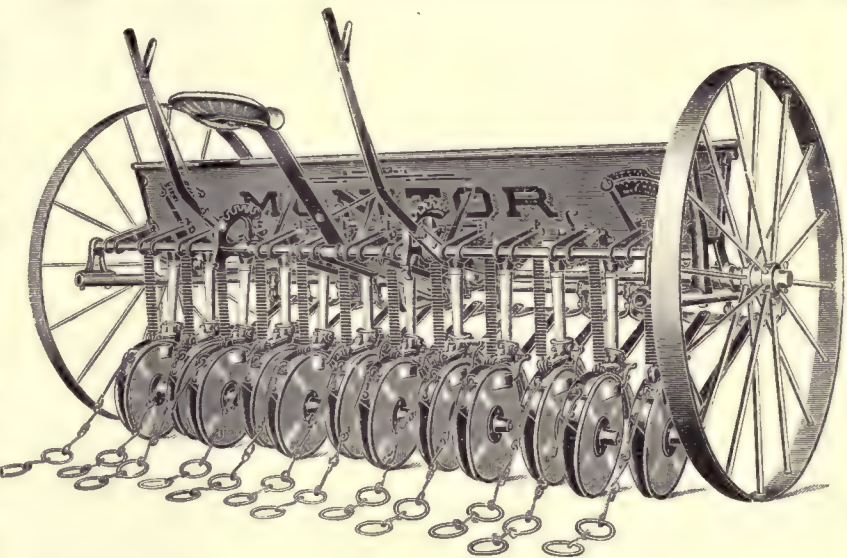
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The American Irrigation Federation

This Federation is organized for the promotion and encouragement of the irrigation, reclamation, colonization and development of land within the United States of America. It maintains an office at 1110 First National Bank Building, 38 South Dearborn Street, where there is open to the public, free of charge, maps and publications relating to the lands of the United States. Questions relating to irrigation matters will be answered by the officers of the Federation and information given.

THE OFFICERS OF THE FEDERATION ARE:

EDMUND T. PERKINS, President
HENRY C. WOOD, Vice-President
D. H. ANDERSON, Secretary
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Organizations and individuals interested in reclamation are invited to become members. Detailed information concerning initiation fees and dues will be furnished upon application to the secretary. Address

D. H. Anderson, Secretary
30 North Dearborn St.,
Chicago, Ill.

300 feet above the tract to be reclaimed. It will require 486 feet of pipe line to carry the water into the coulee.

William R. King, a well known consulting engineer of Portland, Oregon, has filed an appropriation of 2,000 cubic feet of water to be taken from the Yakima river at Frosser. Surveyors in Mr. King's employ are making a preliminary survey of the old Ledbetter ditch, or what is known in that vicinity as the Benton project. Mr. King, when interviewed, stated that he was going to make a survey of the Benton project, along the same general lines of the old Ledbetter ditch, to see if the project was feasible, and had only filed on the 2,000 cubic feet of water as a precautionary measure. It is rumored that the Northern Pacific Railway has taken hold of the old Benton project and will push it to rapid completion.

Active construction work on the Palouse irrigation project, designed to reclaim 110,000 acres of land in the Palouse and Snake River valleys in Franklin county, 150 miles southwest of Spokane, will be started within three

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years. The completion of the work involves an expenditure of \$5,000,000 to \$6,000,000. The Palouse irrigation project has already cost the government \$76,000 for surveys. The original plan was to reclaim 110,000 acres. From 400,000 to 600,000 acres are available. The work was well under way when suddenly called off.

Preston Farms Company has been organized by R. G. Belden, A. B. Wayland and I. H. Preston of Spokane, with a capitalization of \$100,000 to develop a hay, stock and fruit ranch of 750 acres at Midvale, Idaho.

Chester Congdon of Duluth, Minn., who owns a tract of land at Beverly, Wash., formerly held by the Beverly Investment Company, is arranging to put a portion of the land under irrigation and have it ready for planting this year. He will expend \$20,000 to irrigate the first unit of 1,250 acres. There are 4,000 acres in the tract. The machinery is already on the ground, a pipe line is

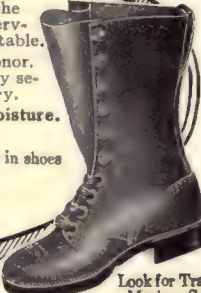
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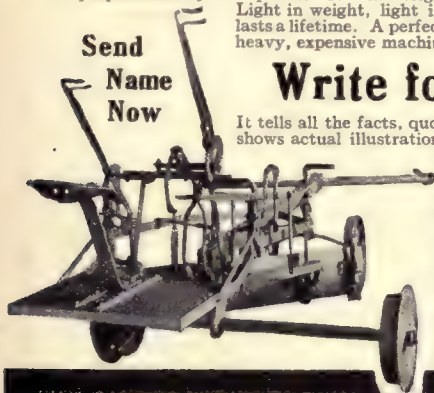
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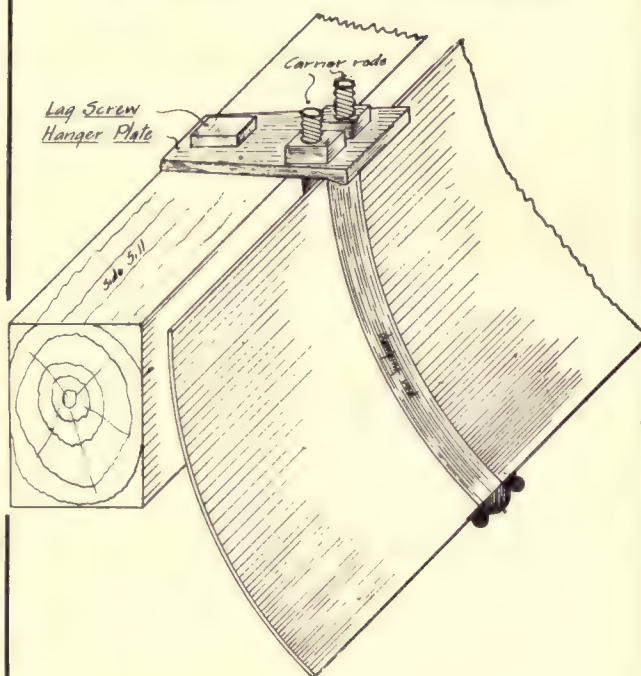
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Added to large experience as an author of reliable standard books, Mr. Hill has had opportunities which specially fitted him for the preparation of this later book. Born and reared on a bleak, sterile Vermont farm where hard labor and continual renovation of soil was a necessity, he has traveled extensively in later years over the United States, has made a study of soils and farming conditions and for several years has acquainted himself with opportunities for land seekers, emigrants and new settlers in all parts of the United States. The results of his study and investigation are seen in this new publication, "Hill's Reference Guide for Land Seekers."

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It Contains a Census Report, giving the latest population of the states, the number of persons in each state to the square mile, growth in the past 20 years, and 1910 populations of each city and village in the United States, containing 200 people and more.

Government Irrigated Lands—It contains map and description of each of the government irrigation projects in the United States, number of acres irrigated by each, amount of water supplied by each, where government irrigated land may be bought and in how small or large quantities, conditions of purchase, location of government land offices, where application for irrigated land may be made, etc.

Prices of Farm Lands in Eastern States—Extracts from advertisements detailing size of fields, wood lots, maple sugar and apple orchards, number of fruit trees on the premises, brooks running across the farm, condition of the buildings, nearness to village, post-office, railroad stations, etc.

Renovation of Worn-Out Land—A chapter on fertilization of land encourages the land seeker who has bought a run-down farm, by telling him how to so restore the land to its fertile condition as to give him the great crops his land bore in former years.

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to be connected and it is fully expected that 25 per cent of the area will be ready early in April for settlers to do their planting. The project is on the main line of the Chicago, Milwaukee & St. Paul railroad. Otto Weile of Spokane is the consulting engineer.

An irrigation district embracing 20,000 acres has been created at Brewster. The project involves the expenditure of \$1,000,000. Preliminary work is to start immediately. The water rights are easily acquired and the ditch work is easy. There will be 40 miles of ditches. The land has been tied up for a long time with private promotion schemes, and several big deals were pending for land if the outcome of the election was favorable.

MISCELLANEOUS.

At a meeting held at McCook, Neb., on March 1st, initial steps were taken to form an irrigation district, comprising the land in Red Willow county west and north of the town of McCook, covering about 35,000 acres. The project proposed includes a reservoir on the Frenchman river at a point six or seven miles southeast of Imperial in Chase county, capable of storing 40,000 acre feet of water. From this reservoir the water will be ditched into Red Willow county and distributed over the proposed project.

The Goodland Well Development Company, made up of about 30 stockholders, has been formed at Goodland, Kans., for the purpose of drilling wells to tap the underflow and develop irrigation. The wells drilled will be of unusual size and centrifugal pumps and oil burning engines will be installed for the purpose of raising the water to the surface.

The cities of Hobart, Lone Wolf, Lugert, Roosevelt, Mountain Park, Snyder, Tipton and Cold Springs, Okla., and the farmers of the adjoining territory have united in asking the government to revive the irrigation projects started by the national reclamation service in 1903, 1904 and 1905.

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The "back to the land" movement that has drawn so many city people countryward during the last few years has built up many thriving agricultural communities in various parts of the West. On the Government reclamation projects it is estimated that more than 14,000 families have recently taken up their homes. Anticipating the needs of settlers for convenient supply stations and markets the Government engineers in laying out the project set aside tracts at convenient intervals as Government townsites, and auction sales of town lots have been held from time to time as the need arose for business locations and residences. Agricultural activities on the thirty Government projects have reached a point where the prosperity of the settlers is assured and business men are eagerly taking advantage of the opportunities offered at this time to get in on the ground floor in the new towns.

The statistician of the United States Reclamation Service at Washington, D. C., is receiving hundreds of letters from professional and business men and artisans who are anxious to establish themselves in these thriving communities.

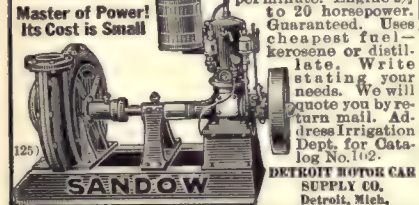
On April 4 there will be an auction sale of lots in the town of Powell, which is centrally located in the Shoshone project in northern Wyoming, and on April 18 lots will be sold in three towns on the Huntley's project, Montana, namely Worden, Ballantine and Pompey's Pillar. In addition several Government towns on other projects have lots now on sale. These include both business and residence locations and the terms are easy.

There is need in several sections for general merchandise, drug, and hardware and implement stores, livery stables, hotels, meat markets, banks. Doctors dentists, and veterinary surgeons are needed and there are splendid openings for many industries.

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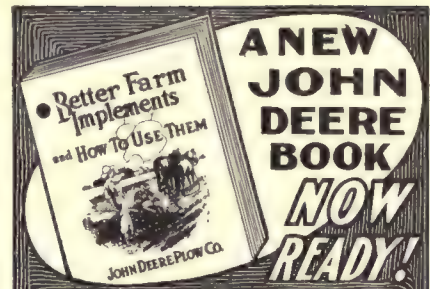
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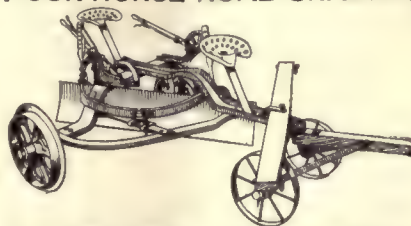
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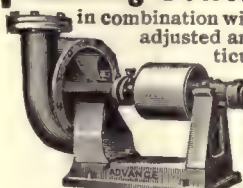
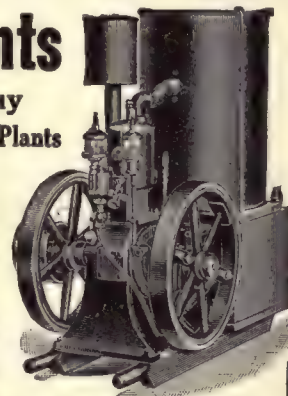
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The best mulch for this region seems to be stable manure that has been rotted or composted for one season. Hen manure mixed with this will add desirable fertility and greatly increase its value. The mulch should be spread evenly between the rows so as partly to cover the plants in the rows. Too heavy a layer on the rows themselves may cause rotting of the plants when warm weather comes on.

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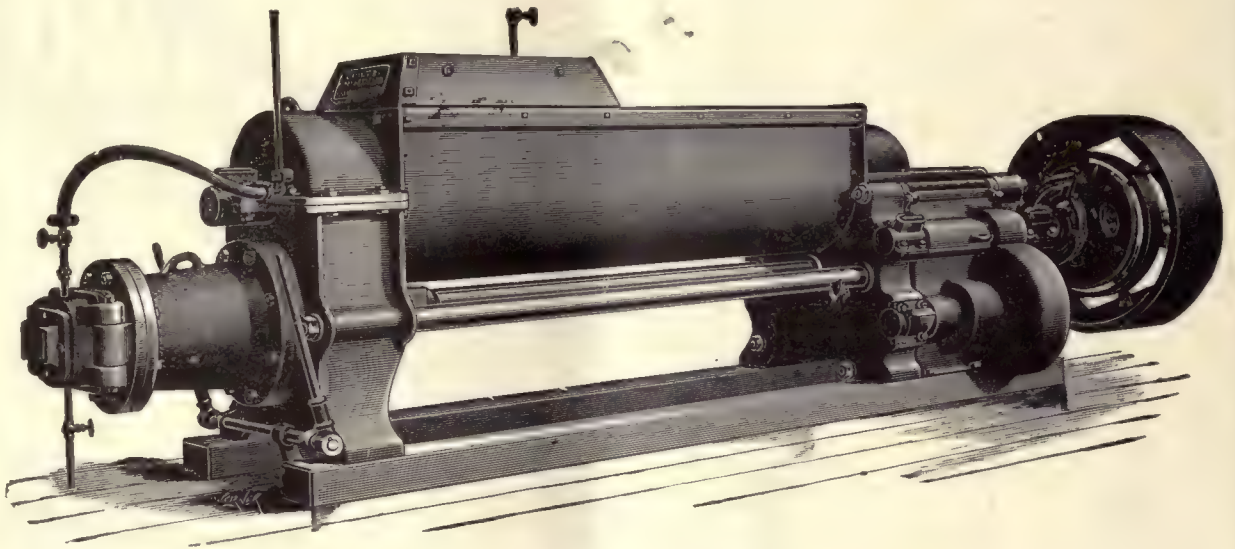
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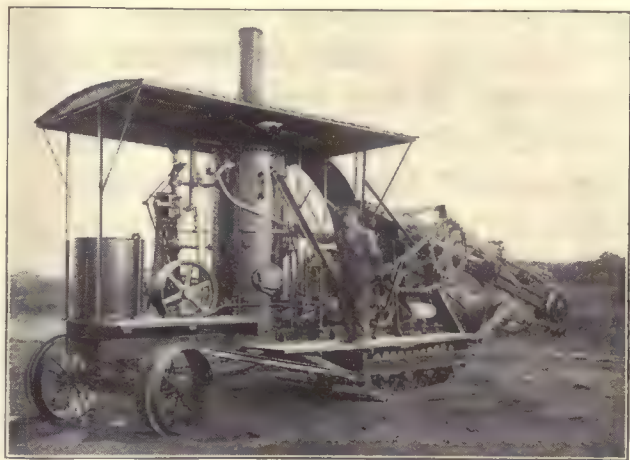
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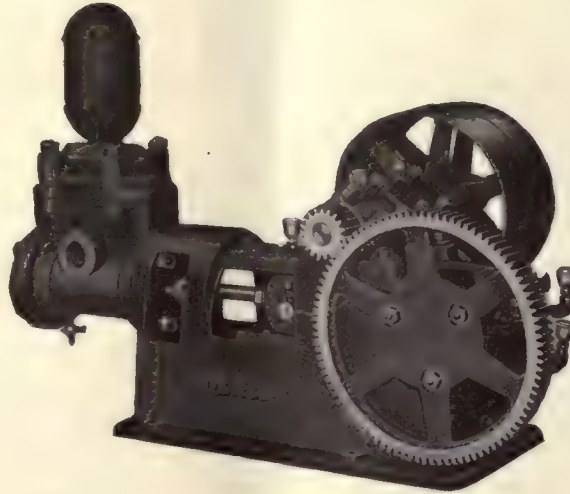
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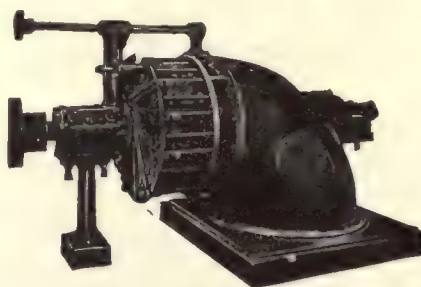


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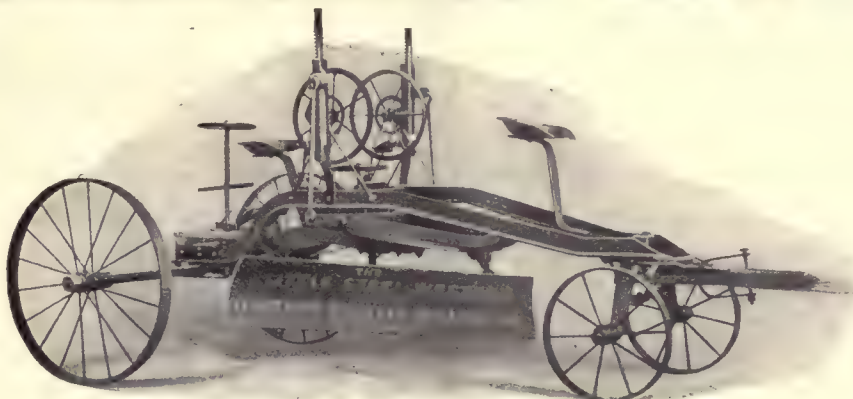
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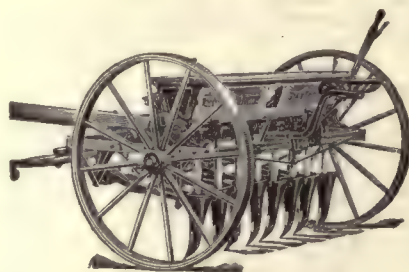
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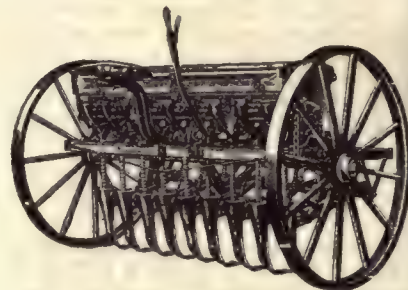
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VOL. XXVII

CHICAGO, APRIL, 1912.

No. 6

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Develop Our Own Farm Lands.

In a recent edition of the Milwaukee (Wis.)
Free Press appears an interesting and in-
structive article in which Secretary of the
State of Wisconsin James A. Frear opens up
the subject of emigration and the develop-
ment of farming lands. He calls attention
to the fact that during the year 1912 there will in all proba-
bility 200,000 settlers leave the United States and go to
Canada to take up farming lands, and incidentally carry
away with them something like two hundred millions of
dollars to be used with their labor to promote the develop-
ment of the western provinces of Canada. He says in part:

Why does the Canadian government, according to report,
spend \$300,000 annually and her railroads as much more for
emigration agents, literature and other advertising methods?
Simply because \$200,000,000 in money and 200,000 settlers is
a stake worth playing for. Neither is this a case of Canadian
reciprocity with any reciprocal returns, because what is
Canada's gain is our loss. What proportion of this loss
strikes Wisconsin, Minnesota and other border states? While
exact data cannot be had, we read the result in Wisconsin's
shrunk population throughout the western counties of the
state that are reached by Twin City agencies, and no man
can study the stationary population of the state outside our
own cities without realizing that we are losing where we
ought to gain.

With threefold better opportunities in Wisconsin for the
average small farmer than are found in Canada, when we
see our people throw away a certainty for hardship and
uncertainty to move across the border, we are free to admit
that advertising pays. Minnesota discovered the danger sev-
eral years ago and now appropriates \$20,000 annually for its
immigration bureau, although this is only 20 per cent of
the amount recommended by Governor Eberhard's message
last year.

If 5 per cent of the Canadian immigration goes from Minnesota and an equal number from Wisconsin, and the proportionate loss to each state is unquestionably greater, it means 10,000 settlers will leave this state in 1912, carrying away with them approximately \$10,000,000 in money or property.

To stem this loss, Wisconsin appropriates less than one-tenth part of one per cent. Seven thousand dollars is the sum set apart by law with which to pay office expenses, postage, salaries and exhibitors, with less than half the amount available for advertising, in an effort to combat the flood of Canadian literature and the group of Canadian agents now working in our own state.

Our lands are not half developed. From eight to ten million acres remain uncultivated, which with intensive farming methods, now being introduced in Wisconsin, will increase the present yield many fold. Every effort to acquaint our people with the opportunities to be found in Wisconsin should be put forth. We challenge comparison, either in markets or climate, water or soil, seed or home making possibilities with any other state or country, and when we are able to bring the comparative advantages of our own state home to the discontented farmer in our midst and he is persuaded to direct his energies to his vocation, it is a financial saving to the community and a better citizen for the state.

This note of warning sounded by Mr. Frear is by no means idle talk, but should be seriously considered not only by the border states but by every state in the Union and especially by our national government. Nor is it the factor of advertising alone which draws or drives the United States farmer or settler across the border.

A thorough inquiry should be made into this subject, as it vitally affects the prosperity of our country. Of course Canada has millions of acres of land which can be settled under very liberal homestead laws, which facts are doubtless strong drawing cards for the exodus of American citizens to the Canadian Northwest. In the United States free homestead land has practically disappeared and the cost of land has greatly risen, so that it is difficult for a settler with a small capital to obtain a foothold in the United States, and he naturally turns to the country offering the best conditions. The United States, on the other hand, offers a far more agreeable climate and better and nearer markets, together with the attractive features of civilization which are more pronounced in densely settled countries.

All of these things are factors which should be investigated thoroughly and the widest publicity should be given the results obtained.

One factor particularly needs elucidation, and that is the inability of our farmers at the present time to furnish sufficient food products for our nation while millions upon millions of acres of land lie idle. When this is considered in connection with the loss of 200,000 able-bodied settlers who, no doubt, would rather work these idle millions of acres at home than to go to seek their fortunes in a foreign country, the problem looks almost absurd, and it doesn't take much studying to find out that there is something fundamentally wrong.

The reason is undoubtedly the fact that much of the good farming land in the United States is held too high in price by land speculators, and by the making of unsatisfactory conditions where land is bought on the instalment plan. The average American land owner wants too much profit on his land, and if he were willing to accept a fair interest on his investment the chances are that he would be able to dispose of his land holdings and assist the country by being instrumental in getting twenty or forty or eight acres under cultivation, helping to feed our home nation and keeping several farmers busy near home.

Another point of importance is the old idea of twenty years ago, that it takes 160 acres or more to make a living

on a farm. This fallacious principle is doing an untold amount of harm, as it fills the mind of intending settlers with dread that they will be unable to get along unless they have at least a quarter section of farm land—and if then they see the glowing advertisements of the Canadian railways, telling them how quarter sections of splendid land are given away up there as homesteads, it is easily understood why they flock northward. As a matter of fact, after the Canadian settler from the United States goes up there he finds things different, and many come back, after loss of time and money.

What must be done here in the United States is to educate the people, and especially the rural population, that large farm units are not essential, and that intense cultivation of a few acres will show better results and pay better than the large farms improperly worked. Our government has recognized this fact, and has induced many settlers upon some of its western irrigation projects to reduce their holdings to much smaller units, and the results have been very good.

Summarizing the proposition, we will say with Mr. Frear: By all means advertise your vacant lands, and advertise them through the proper channels, but do not neglect the other points considered, as the advertising alone won't put our vacant lands under cultivation. We have the markets and a good, agreeable climate, and if we extend to the willing settler a helping hand, he will stay at home and help build up the country, swelling the aggregate of a happy and contented nation.

Back to the Place of Birth

It is just twenty-one years since the first National Irrigation Congress organized and met in Salt Lake City. Since that time this organization has done much for the arid West in promoting the interests of irrigation by educating the people to successfully solve the many problems of agriculture in that region.

Much progress has been made during that period in extending knowledge pertaining to agronomy, hydraulics, engineering, irrigation and drainage, so that a great part of what was formerly the great American desert is now an aggregation of successful farms and happy homes, and due credit must be given to the National Irrigation Congress for its share in this work. Much of the Reclamation Work of the Government would probably never have been undertaken had it not been for the activity of this organization.

And it has barely entered upon its full scope of work; there is a multitude of problems constantly arising, due to new conditions which require careful consideration; the principal ones of these are, the most economical use of water for irrigation purposes, a uniform system of water measurements, the amount of water required for various crops, and the most economical methods of transporting water to the lands to be irrigated. The fact seems to be generally admitted that much water has been wasted recently in irrigation, and that a much greater area of land can be served by the exercise of proper economy.

No one doubts that the National Irrigation Congress is best qualified to discuss these questions intelligently and finally adopt the best measures to reach the desired ends.

The Congress will meet in Salt Lake City, early in October, and it should prove to be a very interesting and important meeting which should be attended by the irrigators of Utah and adjoining states as fully as

possible, and delegates should be sent from every state of the Union. Salt Lake City is already making extensive preparations for the entertainment of its visitors and indications are that there will be a large attendance and that a great amount of work will be accomplished for the good of irrigation, and agriculture and allied subjects.

Schools Needed for Farming

After boys or girls leave the grammar schools in Germany at 14 years they are not permitted to go to work as a rule, either in the factory or on the farm, but they are required to attend continuation schools for at least two years more, so that the youngest recruits to the industrial army there are at least 16 years of age. In these continuation schools the children are taught practical subjects mostly, making them similar to our trade schools here; but the great difference lies in the fact that while we have a few of such trade schools in the United States, there are a great many of them in Germany—enough to take care of the population there.

This principle is worthy of imitation on a large scale, and not only should we provide practical schools for the graduates of the city grammar schools, to prepare them for industrial pursuits, but we should go a long step further and provide such continuation schools for the rural population, where the children of the farmers would be taught the principal scientific ideas underlying agriculture. It is true some efforts have been made and are being made in some localities, as, for instance, by the University of Idaho, which maintains "movable" schools of agriculture; but such efforts are only like drops into a bucket. Even our agricultural schools, although doing an immense amount of good, are not sufficient to give the necessary educational facilities to our progressive farming communities.

What should be done is to bring the college to the farmers, instead of expecting them to leave their homes and travel many miles to the nearest college. The way this can be done is to have a practical professor, who might be a good practical farmer with the necessary qualifications, travel from town to town and from schoolhouse to schoolhouse, and deliver the lectures according to a properly worked-out schedule, thus giving the farmers of such districts an opportunity to attend such classes, ask questions and obtain such other information, literature and books as will be proper for such a course. Then, after the lapse of a certain time, the professor should go over the course again and check the work done, learn of the experience in the field and tabulate and analyze such data.

We believe much good can be done by an arrangement as outlined above, and the expenses entailed thereby will be small compared to the great benefits to be derived by the farming population.

What Crops To Raise.

The Department of Agriculture is doing many things to advance the interests of the farmers and dependent industries; one thing might be added, and that is to plan the number of acres which should be devoted for the raising of the different crops. This grand total could then be apportioned to the various states, and by the states among the different counties, and so down to the individual farmers; for instance, the Department of Agriculture has sufficient statistics and data at hand to know

what the home consumption of the various products of the soil will be for one year. Taking this in conjunction with the average yield per acre of any particular crop, it will not be difficult to compute the number of acres that should be sown to wheat, barley, oats, potatoes, etc. Next a chart showing the rate of production through the various states would make it possible to apportion to them their quota, always bearing in mind the crops to which the state is particularly adapted. Then the states, through their government machinery, could reach the individual farmers and suggest to them what crops to raise and how many acres, in order to keep up the average of the State.

An arrangement of this kind would tend to do away with overproduction of one kind of crop and scarcity of another, although it would perhaps be impossible to entirely prevent these two evils, as very abundant crops and crop failures undoubtedly would modify the results.

At any rate we think the suggestion should be discussed by competent authorities, and if indorsed it should be given a trial.

We must try new things if we would progress, but we should not try new things blindly.

A New Feature To Be Added.

A development section will be one of the features of IRRIGATION AGE in the future. This will be edited by Mr. J. B. Adatte, for many years connected with irrigation and mining publications in the West. For our May issue Mr. Adatte is preparing a special article on the San Juan Basin, and, as he is at present personally in the field, the article will be a truthful and vivid story of opportunities for homeseekers and investors, and the development of irrigation property in and around Durango, Dolores, Ignacio, Bayfield, Tiffany, Allison and La Boca, Colorado, as well as Aztec and Farmington, New Mexico.

This information should have an especial value, as the writer is obtaining it on the ground and has had considerable experience along these lines.

Thoughts That Come and Go.

Have you written that letter to your Congressman and Senators, asking for an adequate parcels post system for the United States?

* * *

If not, do it right now. You cannot put a half hour or hour of time to better use. And another thing you should do, is to pledge prospective legislators and Congressmen to support a satisfactory parcels post law.

* * *

Read THE IRRIGATION AGE from cover to cover; it contains nothing but what is of value, of interest to its readers.

* * *

You cannot spend a dollar to better advantage than to subscribe for THE IRRIGATION AGE for one year; after that you won't do without it.

* * *

It is one matter of great satisfaction that the excitement in politics just now does not interfere with the supply of water. There is a good store laid up in the Rocky Mountains fastnesses, which our old friend Sol will liberate in due season.

* * *

Good crop prospects are by all means the best signs of reviving business; when the products of the soil are plentiful, then prosperity reigns.

The Primer of Hydraulics is now ready for delivery. It is the first book on hydraulics designed for the use of practical irrigators.

* * *

The cost of the Primer of Hydraulics is \$2.50, cloth-bound; if ordered with a subscription to IRRIGATION AGE its cost is reduced to \$2.00; \$3.00 will pay for the Primer of Hydraulics and THE IRRIGATION AGE for one year.

* * *

The best man to vote for is the honest man; but see that his convictions and purposes are of the right kind.

* * *

When potatoes began to retail at \$1.75 per bushel in New York and Chicago, even England was willing to come to our rescue to the tune of 100,000 tons of potatoes.

* * *

It is quite likely that there will be an over-production of potatoes this year, on account of the scarcity of them during the past season.

A NEW WESTERN OFFICE.

THE IRRIGATION AGE has opened an office at 1643 Champa street, Denver, Colo., which is in charge of Mr. J. B. Adatte. Mr. Adatte will have charge of the western territory and will send us reports on conditions from that section, which will be of much interest to our readers.

IMPORTANT NOTICE AFFECTING THE MINIDOKA PROJECT, IDAHO.

The Secretary of the Interior has issued the following Public Notice in connection with the Minidoka irrigation project, Idaho.

Under order of March 24, 1911, and to afford an opportunity for the irrigation of the lands above the gravity supply in the Minidoka project, Idaho, on the south side of Snake River, and as preliminary to the regular opening of that portion of the project, water was furnished as applied for on a rental basis for the irrigable lands of the South Side Pumping unit in the irrigation season of 1911.

In pursuance of the said order of March 24, 1911, it is hereby announced that the rental charges for operation and maintenance for the period from April 1, 1911, to December 31, 1911, shall be \$1.10 per acre for each acre of irrigable land within the project (whether or not water was used thereon), as shown on the farm unit plats approved March 1, 1911, and amendments thereof dated April 18, 1911. These charges will become due April 1, 1912, and no water will hereafter be furnished to any farm unit until payment of the amount due against such unit has been made to the proper agent of the United States Reclamation Service at Burley, Idaho.

In order to afford further opportunity for the irrigation of the lands in the South Side Pumping Unit, water will again be furnished as applied for on a rental basis for these lands during the season of 1912.

It is hereby announced that a minimum rental charge of \$1.25 for operation and maintenance for the year 1912 will be made for each acre of irrigable land, as shown on the plats described in paragraph 2, whether or not water is used thereon.

For that portion of the season beginning June 1st and ending August 31, the maximum amount of water which will be furnished for the minimum charge named in paragraph 4 is 1.75 acre-feet of water per acre of land actually in cultivation, approximately equal portions of said amount to be delivered during each month of said period at approximately a uniform rate so far as practical and not in excess of the applicant's proportionate share of the available water supply and capacity of works; provided, however, that a rotation system of delivery may be installed to encourage an economical use of water, and in no case shall more water be delivered than is reasonably required for beneficial use.

All water used on any farm unit during June, July and August, in excess of 1.75 acre-feet per acre of land actually in cultivation thereon shall be charged for at the rate of

twenty cents per acre foot, as measured by the engineers of the Reclamation Service.

All rental charges for operation and maintenance for 1912, including both the minimum rate and the acre-foot charge shall be due on December 1, 1912, and payable to the proper agent of the United States Reclamation Service at Burley, Idaho. No water will be furnished to any farm unit in 1912, or subsequent seasons until all charges due against such unit shall have been paid.

This is a preliminary order made prior to completion of the project to provide for the rental of water during the season of 1912 only, and is not to be construed as the public notice for said project or any part thereof; nor shall the rental charge herein provided for the maintenance and operation of said project for the season of 1912 be considered any part of the cost of construction, or charge for said project, but said cost of construction and charge will be hereafter announced by the Secretary of the Interior in the public notice to be hereafter issued for said project pursuant to the provisions of Section Four (4) of the Reclamation Act of June 17, 1903 (32 Stat. 388).

A PROSPEROUS IRRIGATION UNIT.

The crop report for 1911 on the Eieton Unit of the Yakima irrigation project has been received by the Reclamation Service. It is an interesting statement which illustrates the rapid progress being made in the reclamation of lands which a short time ago were worthless and uninhabited.

The Tieton irrigation system constructed by the Government is one of the most modern and up-to-date in the world. The water supply comes direct from a beautiful mountain lake situated in a national forest. It is carried for many miles in a concrete lined canal and is delivered through an elaborate system of laterals to each farm. The farm units average only 40 acres, and these comparatively small farms are now being subdivided in tracts of five, ten and twenty acres each. In the near future this project will be as compactly settled as the famous orange districts in Southern California.

On the lands irrigated in 1911 more than 52 per cent was in orchards, and only 200 acres were in bearing trees. The young orchards embraced 3,561 acres. A total of 7,180 acres were actually irrigated during the year, and the crops produced had an estimated value of \$206,519 or nearly \$29 per acre.

There are 273 farms supplied with water, of which 218 contained less than 40 acres each, and 138 of them contained less than 20 acres. The average value per acre of crops on the smaller farms was \$47.78, while on the farms of 100 to 120 acres the average value of crops was only \$33.49. These larger farms are fairly well improved, having been under cultivation and partial irrigation for many years, while the farms of smaller size are for the most part situated on the new portions of the project which received water for the first time in 1911.

In view of the fact that of the 7,180 acres irrigated 526 acres were planted too late to produce or to crops which do not yield the first year, and that 1,959 acres were in young orchards with other crops planted between the rows, the yield was remarkable.

The yield of individual crops is especially interesting. The estimated average value of orchard crops is \$108 per acre; potatoes, \$78; melons, \$49; garden crops, \$100; alfalfa, \$20; grain hay, \$12; timothy and clover, \$19.50; pasture, \$25; small grains, \$16; forage crops, corn and grain, from \$16 to \$25.50; and hops, \$760.

More than 200 sales of farm lands under the completed portion of the Tieton Unit were recorded during the year, involving about 2,500 acres of land. Prices ranged from about \$50.00 per acre for unimproved land remote from towns or transportation to \$1,200 per acre for bearing orchards in the vicinity of North Yakima. The average price paid for the 2,500 acres was \$180 per acre. Without irrigation these lands would be practically worthless.

YOU WILL NEED THIS BOOK.

The "Primer of Hydraulics" is the only book teaching Hydraulics in a practical way. Price \$2.50, cloth bound. THE IRRIGATION AGE, Chicago.

SOIL DRAINAGE*

By A. G. McCALL

Professor of Agronomy, Ohio State University.

The soil is a mixture of very fine rock particles and decayed organic matter from plants and animals. However, this material does not occupy all of the space. In dry clay soil about one-half of the space is taken up by the soil particles and the other half is occupied by air. In sandy soils the individual air spaces are larger than



Periwinkle Wilting on Account of the Lack of Film Water.

in clay, but there are fewer of them and they take up only about one-third of the entire space.

For the best growth of crops about one-half of the space not occupied by the soil particles should be divided equally between air and water. If this space becomes entirely filled with water, crops will not thrive, since their roots will not be able to get the air necessary for plant growth. Some plants, such as the cypress and the water lily, have special structures which enable them to obtain air from the water while their roots are entirely submerged, but our common field plants do not have this power.

The water that falls on our fields as rain would in time completely saturate the soil if no drainage were possible. The more nearly level the land, the more readily does the rain pass into it. During a long continued rain the water soaks into the soil until, like a blotter or sponge, it can hold no more. Then the excess of water will flow over the surface to the lowest points in the fields and finally join the creeks and rivers which are

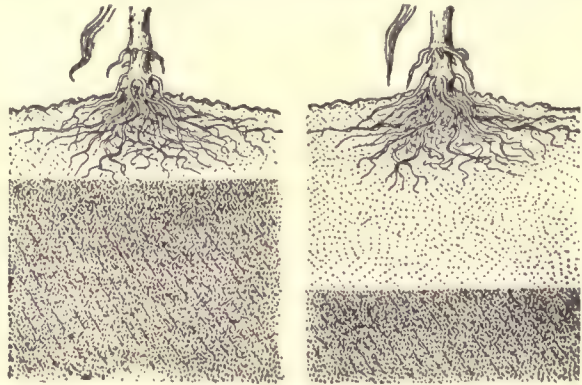


The Same Plant 24 Hours After a Liberal Application of Water.

a part of Nature's great drainage system. At the same time, the water which has passed into the soil gradually soaks into the subsoil and eventually finds its way to the streams. If the soil is a loam or a sandy soil, this natural

drainage will be sufficient. In the case of most clay soils Nature does her work too slowly to be of immediate benefit. Then it is that we should supply artificial drainage to carry away the water more rapidly and thus assist Nature. If the land is quite level, both open ditches and tile drains may be necessary to accomplish the desired results.

Good drainage, then, is the first essential of a productive soil and the foundation upon which all permanent soil improvement must be built. If good drainage is lacking, the benefits which should come from manuring and thorough tillage will not be realized to their full extent. For their best growth, plants should have a moist but not a wet soil; lack of moisture causes the leaves



Corn Planted on a Poorly Drained Soil Will Have a Limited Root Development and Will be Unable to Withstand the Later Summer Drought.

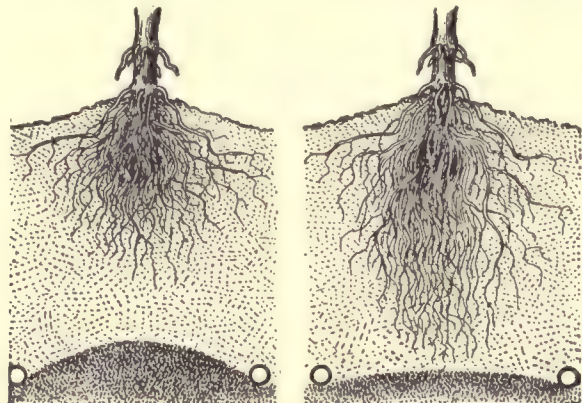
to curl and wither, and too much water in the soil causes the plants to become spindling and yellow.

Good drainage benefits the soil in many different ways, the most important of which are the following:

1. Drainage assists the soil in maintaining the amount of moisture necessary for the best growth of crops. After the excess of water has drained away, a thin film of water remains around the soil particles. It is this film moisture that is most useful to the plant, because it supplies the growing rootlets with food dissolved from the soil, but does not prevent the free passage of air into the soil.

After a long dry period this film may become so thin that the plant roots will no longer be able to secure sufficient moisture and the plant wilts, as shown in the accompanying photograph of the periwinkle.

2. Drainage by encouraging a deep root system, enables the crops to withstand dry weather better. In heavy, undrained soils the water passes downward so



On Well Drained Soils the Corn Roots Strike Down Deep Into the Soil and Are Able to Secure Moisture from Below During the Dry Portion of the Season.

slowly that the plants in their early growth send out only a very shallow root system, because the standing water, or water table, is so near the surface; our common plants will not send their roots into free water to any great

*Abstracted from "The Agricultural College," Ohio State University, December, 1911.

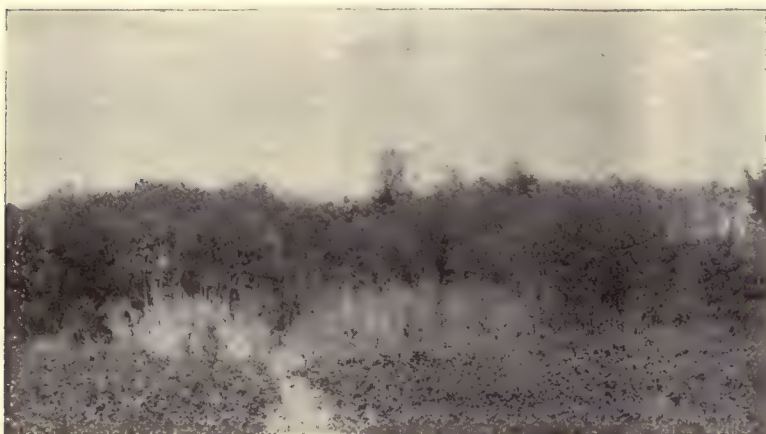
depth. In time, the water makes its way down far below the roots of the plant; a drought comes on and the plant suffers, because the root system in its early life could not extend deep enough to enable it to find sufficient film water from which to draw its moisture during the dry period.

For example, corn that was planted in a wet soil in May will be found to have made shallow root development by August, when the usual drought comes on, and to lack possession of a sufficient depth of soil to furnish moisture for this trying time. On the other hand, the well-drained soils that are driest in May usually have the largest amount of available moisture in July and August, because the larger root development in this land places the plant in contact with a larger amount of soil during the late summer drought.

The deeper the soil condition will permit a tile drain to be placed the better the results will be. The space between the water table and the mulch at the surface represents the territory in which the roots may obtain plant



The Same Field, Growing a Fair Crop of Corn, One Year After It Had Been Drained. It Will Require Three or Four Years to Get the Full Benefit of the Drainage.



Low Swamp Land—Waste Land in Every Sense of the Word, Since It Yields No Crop and Is a Menace to the Health of the Community.

food. The better the drainage, the larger the supply of food which the plant can use. This may seem contradictory when one is reminded that the underdrain carries away dissolved plant food. But the gains from drainage are in every way far greater than the losses.

3. Drainage makes the soil warmer. Soil that is saturated with water warms in the sunshine very slowly, as compared with a soil that is well drained, because the amount of heat required to raise the temperature of a pint of water one degree is about five times as great as the amount necessary to raise the temperature of a pint of dry soil one degree. A drained soil warms up more rapidly in the spring and permits an earlier planting. This lengthens the growing season and insures early maturity, which is an important consideration, especially in the case of early garden crops.

The drainage of wet land is a paying investment and in many instances the increase in the value of the crop is sufficient to pay, in a few years, the entire cost of the drainage.

The accompanying photographs show the result of drainage on an Ohio farm in Champaign county.

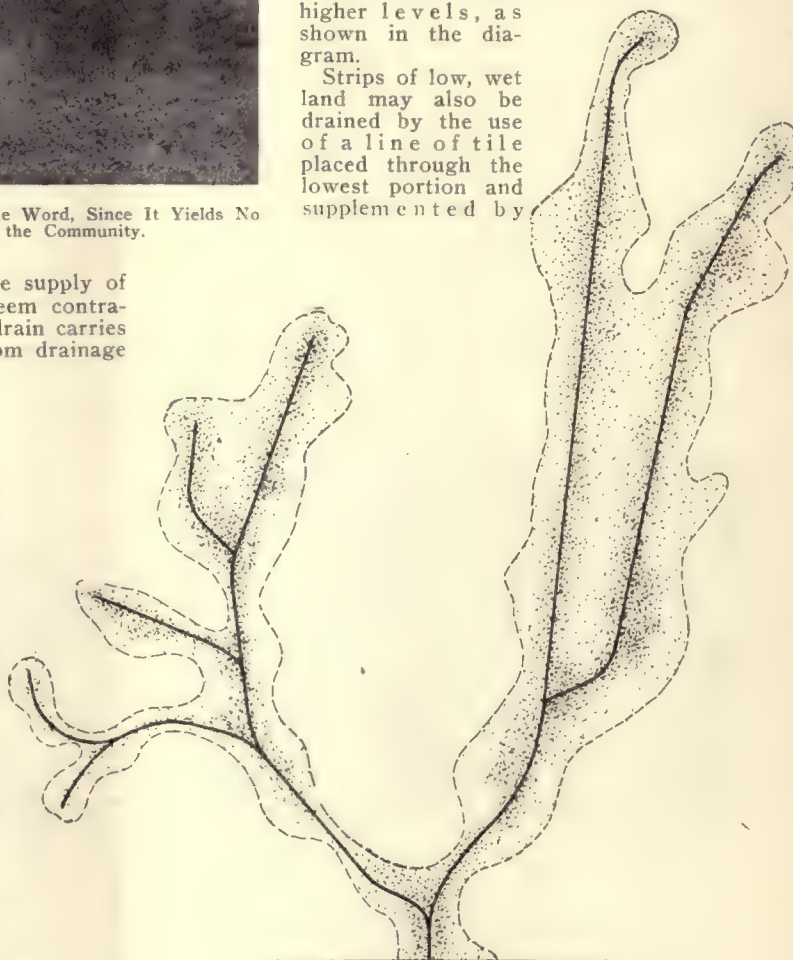
In general, there are two conditions of land in Ohio that require drainage:

1. Low lands that are flooded with water from the higher surrounding land.

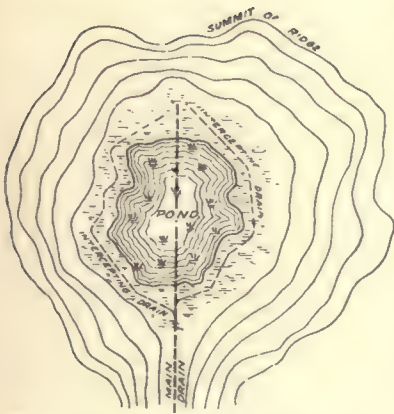
2. Comparatively level fields or rolling tracts of heavy clay soil on which the water stands at or near the surface for several days after a heavy rain.

For most low lands that are flooded from the higher lands, the remedy is quite simple. These lands are in the form of a basin, the bottom of which is impervious. Drainage is accomplished by cutting a deep open ditch through the rim of the basin or providing a large tile through which the water may escape to the nearest stream. This may be supplemented by lines of tile or open ditches which will intercept the water as it flows from the higher levels, as shown in the diagram.

Strips of low, wet land may also be drained by the use of a line of tile placed through the lowest portion and supplemented by



Strips of Wet Land May Be Drained By Lines of Tile Placed Through the Lowest Portion. The Parallel Lines at the Bottom Represent an Open Ditch or Creek.



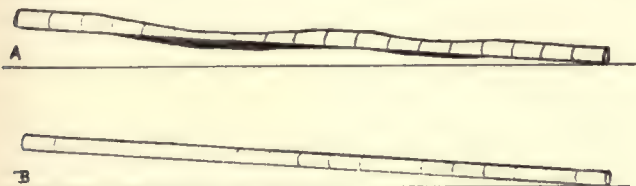
For Low Basins That Are Flooded from Higher Lands the Remedy Is Simple.

a question of time until the standing water will rise to the surface after a heavy rain and injure the roots of growing crops. This rise of water may be prevented by placing lines of tile some distance below the surface, sloping them gradually to a common outlet.

There is a mistaken idea that when rain falls upon land that is tiled, the water will percolate through the soil until it reaches the tile and then enter the drain from the top and run away. After a heavy rain, the water settles almost straight down into the soil until it reaches the standing water, which may be many feet below the surface. As the rain continues to fall, the water level in the soil rises as it would in a basin into which water is being poured; finally, the water level will approach the surface, and, if nothing prevents, will continue to rise until the surface is reached. But if the ground is provided with tile at a depth of about three feet, the water level will not be able to rise above this point; the water will enter the joints from below and run away, if the tile are of adequate size and provided with a free outlet.

This action of tile drains is well shown by means of an apparatus consisting of a tank filled with soil, in which the tile is represented by two small slitted tubes placed at different levels. When water is poured on the surface of the soil, it passes down to the bottom of the tank without starting the tiles, but, if we continue, the water level will rise until it reaches the level of the lower tile through which the surplus water will escape. In the meantime the water has been percolating down through the soil surrounding the upper tile without causing it to flow.

The first step in the construction of a drainage system is the location of the outlet, which must of necessity be lower than the land to be drained. Where the land is slightly rolling this is a comparatively easy matter, since the general direction of the slope of the field is apparent and streams or open ditches are not difficult to reach.



A Shows Improper Grading and Laying of Tile. B Shows Proper Grading and Laying of Tile.

The drainage of many large areas of flat land, however, involves the construction of large county ditches to furnish outlets for the tile and open-surface ditches.

After the outlet is located, the next step is the location of the main line of tile. If the land is slightly rolling the main drain should occupy the lowest part of the

branch lines, as shown in the figure on preceding page.

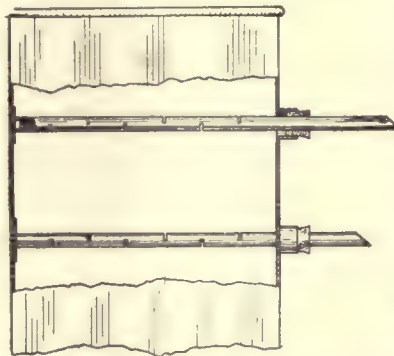
The amount of rainfall in Ohio is sufficient to cover the entire state to a depth of over three feet, if none of it were allowed to run off or sink into the soil. On level lands a large amount of this water soaks into the soil and raises the level of standing water found at some depth in all soils. Unless drainage is provided, it is only

field and follow the general slope as far as possible, so that the laterals or side drains may slope toward the main tile. The location of the laterals will be determined by the contour of the field. As a general thing, they will be spaced at irregular intervals and with the main will form an unsymmetrical branched system, as shown in the figure on Page 9.

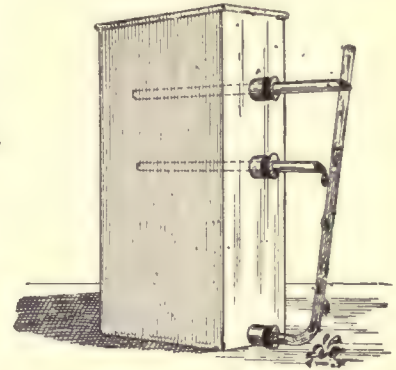
If the surface is comparatively level, the drainage system should be laid out on symmetrical plans. These plans require an open ditch or a main line of tile across the lowest side of the field at right angles to the general slope of the surface. The laterals are placed at regular intervals parallel to each other, and at right angles to the main ditch, if the long side of the field borders on the ditch. If the field is long and narrow, with the short side bordering the ditch, it will be best to provide one long main at right angles to the ditch, with short laterals branching off at regular intervals.

After the most desirable system has been determined, the laterals and mains should be located by guide stakes placed at intervals of 100 feet along the proposed line of tile. If the surface of the land has a decided slope, the ditch may be dug and graded without the use of a level. The digging should begin at the outlet and proceed up the line. If water is available, a uniform fall may be secured by carefully cleaning out the bottom of the ditch until the flow of water toward the outlet is uniform at all points. Where a fall of two inches per hundred feet is desired, it may be obtained by placing a dam two inches high across the bottom of the ditch at a point where the desired grade has been reached and cutting out the bottom of the ditch above until the water backs up to a point just one hundred feet above the dam.

Drains which have a fall of two to four inches per hundred feet will prove entirely satisfactory, if the work



Drainage Apparatus Used to Show the Action of Tile in a Drained Soil. The Drawing at the Right Shows the Apparatus in Use. The Height of the Water Table Is Indicated by the Level of the Liquid in the Glass Tube. The Figure to the Left Is a Cross-Section Showing the Slitted Tubes in Place.



is carefully done. Where it is possible, the grade should not be less than two inches per hundred feet.

Great care should be exercised to have the bottom of the tile on a smooth, uniform grade. If the tile are out of line, silt will collect at the low points and clog the drain. The grade of the main drain should increase toward the outlet, since this will increase its carrying capacity and stimulate a more liberal flow from the laterals.

Wherever a lateral joins the main drain or where two drains unite, the junction should be made at an acute angle, in order to better direct the water toward the outlet. If possible, the lateral should have an increased grade for a few feet back, to give additional velocity to the discharge. The correct method is shown in the figure above.

A long drain will carry less water than a shorter drain of the same diameter, because of the additional friction encountered. The carrying capacity of the drain is also dependent upon the grade or fall, hence the steeper the grade the smaller the tile that may be used. If we increase the grade from two inches to four inches per hundred feet, we increase the capacity of the drain one-third.

With a reasonable grade, a three-inch tile will drain

five acres, if the length of the drain is not more than one thousand feet.

Under the same conditions:

A four-inch tile will drain twelve acres.

A five-inch tile will drain twenty acres.

A six-inch tile will drain forty acres.

These figures refer to the main drain. The lateral

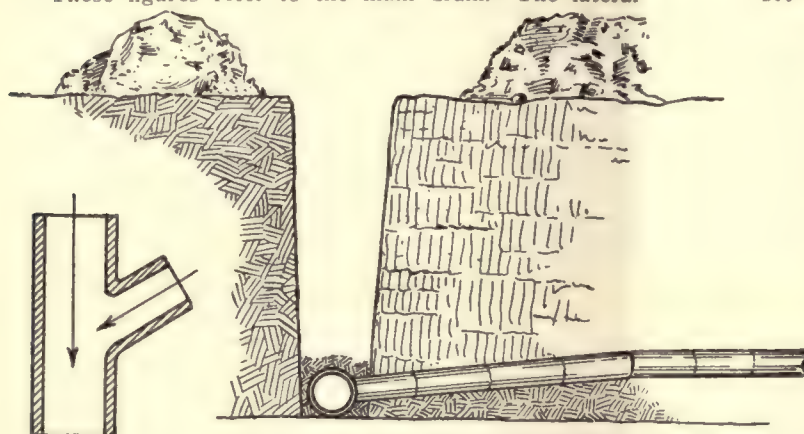
feet of tile which will be required per acre, when laid in parallel lines:

20 feet apart.....	2205 feet
30 feet apart.....	1470 feet
40 feet apart.....	1102 feet
50 feet apart.....	880 feet
100 feet apart.....	440 feet

This does not include the intercepting drain which may be necessary in some cases to complete the system.

The tile should be well burned and hard enough to give a clear ring when struck with a shovel or a piece of metal. They should be circular in shape and uniform in size, so as to make a smooth joint. It is not necessary that the tile should be porous, since the water enters the system through the space at the joints and not through the walls of the tile.

Ordinary unglazed tile when exposed to the weather are chipped and injured by freezing and thawing, hence the last few feet of the system should be of glazed tile or iron sewer pipe. The outlet should be further protected from injury by imbedding the last joint in a concrete wall or in stone laid up in cement mortar.



Laterals Should Join the Main Drain at an Acute Angle and With a Slightly Increased Grade for a Few Feet.

branches must be proportional to the main drain. In considering this matter it must be remembered that capacities of tile laid upon the same grade are to each other as the squares of their diameters. For example, the capacity of a two-inch tile is to the capacity of a four-inch tile as four to sixteen; or, in other words, the four-inch tile has four times the capacity of a two-inch.

The depth of the drain is so intimately connected with the distance between the lines of tile, that it is impossible to fix on the one without taking into consideration the other. In general, it may be said that a tile four feet deep is considered deep drainage, two and a half to three feet medium, and two feet shallow drainage. Deep drainage should be practiced wherever the soil conditions will permit. Many have the mistaken idea that the removal of surface water is the sole object of drainage, and lose sight of the benefits which deep drainage brings in the way of increased depth of soil and deeper root penetration.

In order to arrive at an intelligent decision as to the proper depth and distance apart of tile drains, it is necessary to understand the fundamental principles connected with the movement of soil water, as discussed in the first part of this bulletin.

In loam soils the drains may be placed deeper and farther apart than in retentive clay soils.

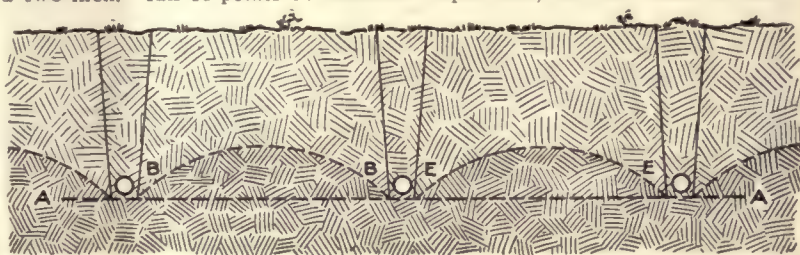
In the following figure, the line BB represents the position of the water table shortly after a heavy rain. If the soil is fairly open, the surface of the ground water will soon take the position AA. This condition will be reached much sooner in an open loam soil than in a retentive clay. Because of the resistance which the soil offers to the movement of the water to the drains, the water table in tenacious clay lands will hold the position BB for some time. At a point midway between the drains the water will stand near the surface if the lines of tile are too far apart, and the field will be only partially drained. If the drains are placed near together, the water table will be lowered more rapidly at the point midway between the lines of tile, and the soil will be more promptly and thoroughly relieved of its surplus water.

For ordinary loam soils the drains may be one hundred feet apart and three and one-half feet deep, but for retentive clay land the depth may have to be reduced to thirty inches and the distance apart to fifty feet. In case of doubt as to the distance apart, it is well to provide drains every one hundred feet, and if these are found inadequate, additional lines may be placed midway between.

The following table gives the approximate number of

FARMERS' NATIONAL CONGRESS.

The thirty-second annual session of the Farmers' National Congress will be held in New Orleans, Louisiana, convening November 7. New Orleans—called variously the Crescent City and the Queen City of the Gulf—presents some remarkable attractions. It is quaint and picturesque, being full of points of historical importance, and its French section



A Section Through a Tile-Drained Soil. BB, the Surface of the Ground Water Soon After a Heavy Rain, and AA, the Position of the Ground Water Some Days Later.

having the appearance of a foreign city. Yet the spirit of progress pervades New Orleans. Many of its hotels and newer buildings represent everything that is up to date, noteworthy being the famous Hotel Grunewald, the Waldorf-Astoria of the South. Situated at the mouth of the greatest system of inland waterways in the world, it has one of the most interesting harbors in the country, and is already the third largest port in point of commerce in the United States. The system of levees, protecting the city from the river, is extremely interesting, much of the city being below the water level of the river. All in all, it is one of the most interesting places that the congress has ever visited.

From present indications, every state will be well represented at this meeting. The most important business of the congress is the passing of resolutions, and the leading topics of special interest to the agriculture of the nation will be presented for consideration. It is too early yet to announce any railroad rates, but there are excursion and tourist rates from northern points available every winter, and there is every reason to suppose that the same will hold true this year. Meanwhile efforts will be made to secure additional concessions, if possible. For information as to appointments as delegates, etc., address J. H. Kimble, Secretary, Port Deposit, Maryland.

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PROGRESS OF THE RECLAMATION WORK.

*Arizona, Salt River Project (93.5 per cent completed).—*The two water wheels, which will utilize water from the Roosevelt Reservoir, arrived and were being hauled to Roosevelt. Work on the equipment of the San Francisco Pumping Plant was completed with the exception of grading and fencing the grounds. The erection of the Salt River Valley Water Users Association transmission line from the Switching Station to the South Consolidated Power Plant, a distance of 8 1-3 miles, was commenced and about eight-tenths of the poles were erected and the stringing of wires begun. The excavation for the South Consolidated Power Plant, by contract, was finished and the placing of forms for the structure was commenced. The water users' association awarded contract, and excavation was commenced, for the erection of the Arizona Falls Power Plant building and spillway. On the Arizona Canal the dredge remained idle. The excavator covered a distance of 5,500 feet by the 20th when it was necessary to stop for repairs. Material for the Cave Creek structure was on the ground and the forms were built. The widening of the Grand Canal progressed satisfactorily. The contractors finished and moved their outfit back to the Grand Canal extension on the 22d. Practically all of the wooden structures required for handling water in the new header ditches were installed. Engineering parties were engaged upon the Grand and Arizona Canals and lateral work. Constant water service was maintained in the south side system. On the north side unit service was rendered constantly in the Arizona Canal, rotated between the Salt River Valley and Maricopa Canals, and as much water as possible was delivered into the lower end of the Grand Canal through the Arizona laterals. It was impossible to use the upper portion of the Grand Canal on account of the enlargement work being carried on by the water users' association. The demands on the system were heavier than during December due to the warm weather starting the growth of vegetation. All demands were taken care of with the exception of those from water users under the Grand Canal. All water necessary up to and including the 6th of the month was furnished by the Verde River, supplemented by that which was delivered through the Power Canal. The daily average for this period was 115 second-feet. The valves in Tunnel No. 2 were opened on the evening of the 6th and a daily average of 580 second-feet was delivered during the remainder of the month. On January 25 the elevation of water surface in the reservoir was 153.75 feet, contents 437,919 acre-feet; the net loss for the month having been .44 foot in elevation, and 3,917 acre-feet in contents. The maintenance force placed some necessary pipe culverts under the Western Canal; also some new work incidental to the connection of a portion of the well system. A decided increase in temperature during the month assisted materially in starting general agricultural pursuits and a large amount of work was carried on in the valley, considerable new land having been brought under cultivation. The citrus crop was picked and shipped, excepting such as was held for local consumption. About 70 cars of oranges and pomelos were shipped from the valley. The cold weather of last month necessitated the replanting of approximately 500 acres of sugar beets. To date about 3,000 acres have been planted to this crop.

*Arizona-California, Yuma Project (62 per cent completed).—*At Laguna Dam no work of importance was in progress. About 20 men were engaged in protecting the bank of the Colorado River on the California side, about three miles below Laguna Dam and the construction of brush dikes, about 12 miles below Yuma, was continued with the aid of the steamboat. Work on the Main Canal, California side, progressed steadily on all six sections under contract. Schedule 1 was completed, and schedules 2, 3 and 6 were approximately 50 per cent completed. Schedules 4 and 5 were in such shape at the close of the month that the organization at work upon them appeared sufficient to complete the work within the time agreed upon in the contract. Approximately 795 head of stock and 390 men were employed by the various contractors. The central pier and one abutment for the Howe truss bridge across the canal at Picacho Road were completed. The forms for the other abutment were in place. On the Arizona side, one Government construction camp was engaged on the distribution system near Laguna Dam, five camps were employed in the construction of the Main Canal on the east side of Yuma

Valley below Yuma, and one camp was at work on the west branch of the Main Canal. About 19 miles of main canal in Yuma Valley were completed. Construction of the Colorado siphon progressed steadily. The tunnel was completed to a point 485 feet from the Arizona shaft and the top half of the tunnel was driven a distance of 50 feet further. The entrance structure was completed, with the exception of a small amount of ornamental work. The First Street Bridge was practically finished; the Third Street Bridge was about 75 per cent completed, and work was well under way on the turnout near Second Street. The pumping plants for the irrigation of small areas below Yuma were put in operation on the 22d. Prior to that date a small force had been employed in cleaning ditches and repairing the plants. One engineering camp was located on the California side of the Colorado River to take care of the contract work. Two parties were located in Yuma Valley marking lines and grades on canal construction, and locating new canals. A third party was engaged along the river about thirty miles above Laguna Dam, determining the backwater caused by this structure. The discharge of the Colorado River at Yuma averaged 5,000 second-feet, with a maximum of 8,200 and a minimum of 3,400 second-feet.

*California, Orland Project (84 per cent completed).—*Weather conditions were unfavorable for construction work, the temperature having ranged from a maximum of 64° to a minimum of 27° with a precipitation of 2.67 inches. No water was used for irrigating and there remained in storage at East Park Reservoir 17,700 acre feet of water at the close of the month. Construction work, repairs, and cleaning laterals of the distribution system were continued whenever the weather would permit. Riprapping for the protection of drops was completed, 16 miles of laterals were cleaned and repaired, and 3,000 square yards of 1½-inch concrete lining were placed. The old timber structures on the North Canal were torn out and the work of replacing them with concrete was commenced. The rotary screening plant and other equipment used in the East Park Spillway extension was overhauled and stored in readiness for transfer. An order was placed on the 15th for a small excavator to be installed at the south side headworks as permanent operating equipment. A number of settlers moved to their farms during the month and there was greater activity in leveling land than during any previous month.

*Colorado, Grand Valley Project (Preliminary work).—*Satisfactory progress was made in securing agreements providing for settlement for damages to arise from the occupation of the right of way for the Main Supply Canal through the Mesa County Irrigation District. Up to the 26th of the month the owners of 85 of the 102 right of way tracts entered after October 2, 1888, had accepted the offers tendered by the United States, and executed agreements. All but one of the resident owners of these tracts have accepted the terms offered; the non-resident owners are responding slowly. Agreements to sell the canal right of way have been negotiated covering six of the eleven tracts in the Mesa County District, across which the United States did not reserve a canal right of way in the patent. Negotiations have been initiated to ascertain whether or not the main diversion canal should provide carrying capacity for the irrigation water of the Mesa County Irrigation District. An examination of the subscriptions to the water users' association, with the object of having technical defects in execution corrected, was partially completed. A small field party made a detailed topographic survey of the site of the proposed power house and wasteway near Palisade.

Colorado, Uncompahgre Valley Project.—The concrete sluiceway and canal intake of the Montrose and Delta Canal headworks were completed with the exception of concreting the gates and hoists in place. A 77 linear-foot Maginnis steel flume was built on the Cedar Valley High Line over Cedar Creek. The construction of the Gunnison River Weir was completed with the exception of concreting the hoists in place. Logs were placed in the apron for a distance of 75 linear feet, and the apron was entirely backfilled with rocks for the same distance. Sand was then sluiced into the complete structure in order to fill all voids in the rockfill, after which the 6-inch top plank was spiked to the apron. A concrete fishway was built at the west end of the weir adjacent to the sluiceway. Work was commenced on the Gunnison Tunnel preparatory to the placing of 12,190 linear feet of concrete floor between station 2+15 and station

167+60, and the repairs to be made to the floor and walls between station 173+50 and station 205+50. Work was continued on the construction improvements on the South Canal. The rail grills and concrete piers were removed from four of the drops. The construction of a four-room section house, located on the west side of Coal Creek Valley, at the head of the King Lateral extension, was completed. Maintenance work on the Government canals was carried on as follows: On the Montrose and Delta Canal system 10 miles of the main line and 14 miles of laterals were cleared of brush; repairs were made to the timber flumes crossing over Happy Canyon Creek and Spring Creek; the old bridge over the canal at Happy Canyon Creek was replaced; a new timber headgate was built for the East Coal Creek Lateral and some riprapping was placed at the King Lateral diversion dam below the "Big Drop" on the Montrose and Delta Canal. On the Loutsenhizer Canal system two miles of the main line and four miles of laterals were cleared of brush; and a new timber flume was built to replace the old Lupper Flume. Five miles of the main line of the High Line Canal, two miles of the Twin Buttes Lateral of the High Line and one mile of the Reservation Canal were cleared of brush. Bids were opened on the 23d for the construction of the West Canal from station 52+50 to station 605+00. Eleven bids were received, five of which covered all schedules, and four covered the tunnel schedule. Work was begun on the location of the Spring Lateral extension to Dry Creek and on the traverse surveys of the Ironstone Canal system; the traverse survey of the High Line Canal from the Uncompahgre River to Cedar Creek was completed; and additional topography was taken along the line of the East Canal. The contractors completed the erection of the dredge preparatory to active construction on the enlarging of the East Canal. Severe weather conditions retarded construction work, the ground having been frozen to a depth of from two to three feet. The temperature ranged from a maximum of 51° to a minimum of -7°, mean 30°.

Idaho, Boise Project (exclusive of Arrowrock Reservoir, 89 per cent completed; Arrowrock Reservoir, 15 per cent completed).—Enlargement of the Main Canal, between stations 789 and 799, by contract, did not progress satisfactorily. It was, however, about 99 per cent completed at the close of the month. The gravel facing on the Lower Deer Flat embankment was completed and part of the equipment was shipped to Arrowrock for use on the dam. A portion of it was hauled to the Upper Deer Flat embankment for further use at that point if repairs become necessary. Only very desultory work was in progress on the construction of the lateral system. Considerable work was accomplished, however, at the camps in sawing up lumber and getting it into shape for installing structures when the weather becomes favorable.

Arrowrock Reservoir: Cold weather and unusually heavy snows interfered considerably with progress, and several times the work was threatened with flood due to rain which fell on freshly fallen snow but no damage was done and the work is now beyond danger from floods this season. A total of 78½ inches of snow has fallen so far during this winter. Labor conditions remained about the same as during the past several months. The force was reduced considerably during the latter part of the month on account of the completion of present operations on the diversion works. The sawing of lumber was continued with fairly good success considering the unfavorable weather conditions. Concrete and timber lining of the diversion tunnel was completed. The concrete work in the inlet and outlet bell mouths was completed and the timber crib construction in these bell mouths was completed as far as it will be carried this season. Snow slides caused some trouble in the operation of the railroad but the daily train schedule was maintained with very few exceptions and no delay was experienced in getting the necessary materials and supplies. Satisfactory progress was made on the work at the power house at the diversion dam, considering the unfavorable weather conditions. The generator floor was completed the trash rack forebay was finished, the installation of the wheel-pit gates was well under way, and the installation of the hydraulic machinery was commenced. A number of small items of equipment were received and two cableways and a 70-ton steam shovel are en route.

NEBRASKA'S IRRIGATION STATISTICS.

The total number of farms irrigated in 1909 was 1,852, against 1,932 in 1899, a decrease of 80, or 4.1 per cent. Within the same period the number of farms in the state had increased 6.5 per cent. Neither item changed materially during the period covered.

The total acreage irrigated in 1909 was 256,350 acres, against 148,538 acres in 1899, an increase of 107,812 acres, or 72.6 per cent. During the same period the improved acreage on farms increased but 32.1 per cent, showing that irrigation development was more rapid than agricultural development generally. The area irrigated is but 1 per cent of the improved land in farms, and lies principally in the valley of the North Platte river.

The total acreage which all enterprises were capable of irrigating in 1910 was 429,725 acres, an excess of 173,375 acres over the area irrigated in 1909. The acreage included in projects either completed or under construction in 1910 was 680,633 acres, an excess of 424,283 acres over the area irrigated in 1909. This indicates the area which will be available within the next few years for the extension of irrigation, and shows that the area irrigated can be more than doubled without the construction of additional works.

The number of independent enterprises reported in 1909 was 474. The total length of ditches in 1909 was 2,725 miles, against 1,701 miles in 1899, an increase of 1,024 miles, or 60.2 per cent. The number of reservoirs reported was 44, having a combined capacity of 2,097 acre-feet. The number of wells pumped for irrigation was 66 and the number of pumping plants 75. The engine capacity of pumping plants was 52 horsepower, but this does not include windmills, which are counted as pumping plants. The acreage irrigated with pumped water was 157 acres. The total cost of irrigation systems reported in 1910 was \$7,765,110, against \$1,276,978 in 1899, an increase of \$6,488,132, or 508.1 per cent. The average cost per acre in 1910 was \$18.07, against \$7.43 in 1899, an increase of \$10.64, or 143.2 per cent. The average annual cost of operation and maintenance per acre in 1910 was \$1.09.

The acreage irrigated in 1909 has been classified according to the state and Federal laws under which the works were built or are reported, as follows: United States Reclamation Service (act of congress June 17, 1902), 30,536 acres, or 11.9 per cent of the total; United States Indian Service (various acts of congress), 300 acres; irrigation districts, 76,448 acres, or 29.9 per cent of the total; co-operative enterprises, 79,005 acres, or 30.8 per cent; commercial enterprises, 24,834 acres, or 9.7 per cent, and individual or partnership enterprises, 45,227 acres, or 17.6 per cent of total.

Streams supplied 254,523 acres, or 99.5 per cent of the total; of the balance, wells supplied 139 acres, springs 686 acres and reservoirs 1,002 acres.

BEET GROWING A PAYING CROP.

That beet growing is one of the most profitable of Montana agricultural industries is again proved from the figures just given out by the Billings Sugar Company in making its announcement of winners of prizes offered by a local business house to the farmers whose commercial yield per acre was the highest. Records of every grower, the acreage cultivated, the tonnage produced and the amount paid to him, are kept by the big mill, and the list has been carefully tabulated into three groups, according to acreage.

Group No. 1, 5 to 15 acres; No. 2, 15 to 30 acres; and No. 3, over 30 acres. A buggy was awarded as a prize to the farmer making the best record in each class.

H. S. Tippetts held the high mark in the first mentioned, his check being \$797.34 for 7.03 acres, an average of \$113.42 per acre. His crop grew in northern Wyoming, in the vicinity of Lovell.

In the second group, J. G. Eiseman, of Park City, scored first with 15.11 acres, for which he received \$106.04 per acre, a total of \$1,602.26.

John Stewart, who grew 40 acres of beets near Billings, was top-notch in Group 3, and his bank account was increased \$4,028.80 by the Sugar Company's check, the average per acre being \$100.72.

THE STORAGE OF PORTLAND CEMENT.

Portland cement is easily affected by moisture. It is purposely made so; for, combined with water and other substances, it forms the best of all building materials—everlasting concrete. But moisture must be kept away from cement until it is needed for actual use. This means that cement must be stored in places which are and can be kept absolutely dry. Upon the proper storage of cement are dependent the reputation of the contractor or



Cement on the Work Piled Properly on Wooden Platform.

builder, the trade of the local dealer, and the satisfaction of the user.

On account of the quantity which they keep on hand, dealers and contractors often build special houses for the storage of Portland cement. Almost any material will do for the construction, provided it will shed water and remain weather-proof. Frequently, for temporary storage, contractors build sheds of "up and down" plank, covered on the outside with one or more thicknesses of tarred paper. The floor must be above possible high water and open, so that the wind can circulate under it. To make the house more completely damp-proof, the floor should be double or its equivalent. Often the same effect is obtained by a makeshift double floor of loose timbers and boards laid upon the regular floor. For such a temporary shed there is nothing better than a well-made one-way slope tarred paper roof on sheathing laid with tight joints, lengthwise or in clapboard fashion crosswise. Let the roof have a drip or overhang of at least a foot on all sides. See that it is absolutely water-tight, that the rain cannot beat in under the eaves, and that the roof is fixed so firmly that a wind storm will not raise it. It is advisable to put no windows in such a house, and to have the door so securely hinged and fastened as to keep out intruders. Where use of cement in the work is dependent upon acceptance by test, provision for piling should be made in accordance with instructions given below for dealers.

The same general principles stated above apply to storage houses for dealers. Naturally the house is made more permanent in character. Consequently, it should be supported by a concrete foundation extending into the ground below the frost line. Likewise, for a permanent building, there is no material so good as well proportioned concrete. Place the concrete floor on sufficient coarse, compacted gravel or broken stone, and fill to bring the floor level a foot above the surrounding ground. Slope the surface of the

floor toward the door. For a one-story building, a 6-inch reinforced wall is strong enough. With a reinforced concrete roof, the cement will be protected from all possible danger of dampness.

Since Portland cement weighs practically 100 pounds per cubic foot, the beams of the floor elevated above ground must be heavy and be supported at frequent intervals by concrete piers. If window openings are necessary, do not use sash. A strong door, hinged at the top and capable of being fastened on the inside, is much better for keeping out dampness. Often the building has a solid or skeleton lining on the inside, for reasons given under directions for storing cement. It should be well sway-braced on the inside, to prevent springing of cracks or bulging.

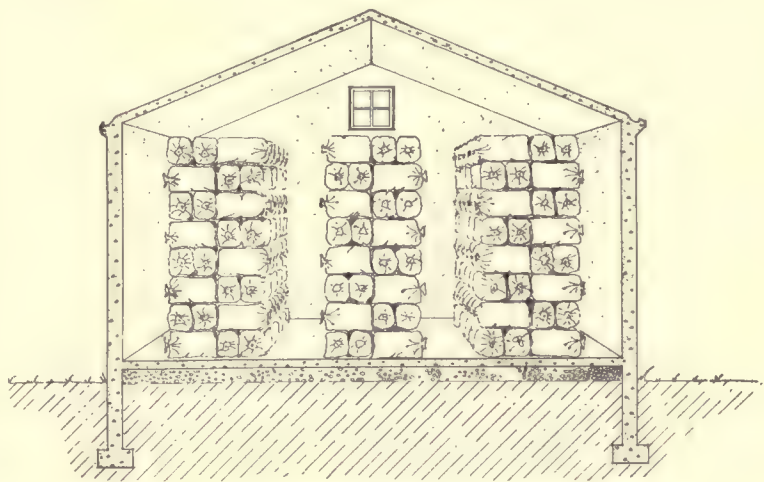
The size of the house is dependent upon the extent and character of the dealer's trade. An average carload of Portland cement contains about 175 to 200 barrels of four bags each. In determining the necessary size of the cement sheds, consider that each bag of cement stored will occupy one cubic foot. Do not build too small. There is an increasing demand everywhere for Portland cement, and the trade of local dealers is far surpassing expectations.

The character of the trade has much to do with fixing the size of the storage house. Especially dealers who supply contractors should have sufficient room to keep every shipment separate; for cement used by contractors and builders must often pass a seven- or twenty-eight day test before being used. Moreover, every cement storage house should be large enough to have aisles between the piles of various shipments, so that cement may

be removed from storage in the same rotation as it was put in.

Many users of Portland cement need to store it only for the short interval between the time of hauling it from the dealer and using it in the concrete work. Any building with a good roof, tight side walls, and a dry floor will do. Make a temporary double floor by means of small beams or logs and loose boards. See that driving rains or damp air cannot reach the cement.

Portland cement weighs nearly 100 pounds per cubic foot, therefore judgment must be exercised in loading the floor. Likewise, on account of its weight and possible damage from dampness, do not pile the cement against the side walls of the building unless the house is full



Cross-Section of Concrete Storage House with Cement Correctly Piled.

lined or skeleton lined on the inside. Store the cement so as to leave an open space or an aisle along the side walls and aisles at places necessary to separate ship-

ment. Get rid of all possibility of the cement piles toppling over by laying the bags, as a mason would say, "headers and stretchers"; that is, alternately lengthwise and crosswise, so as to tie the pile together. Examine the building frequently to see that there are no leaks in the roof or side walls.

Even on the work, never pile cement on the ground or on bricks. Throw down a few blocks, lay boards upon them and make a dry floor for the cement. Have just enough cement on the work to keep things going. A good tarpaulin is handy to cover up the cement in case of a sudden shower. Always buy cement from the dealer who has a dry storehouse. If the cement in the bag has been wet, it is hard as a rock; do not use it under any circumstances. However, do not mistake lumps caused by pressure in the storehouse for "set-up" cement. Such lumps crumble easily and the cement is perfectly good. Take care of the Portland cement just as carefully after receiving it as a good dealer does, and, properly mixed with sand and stone or gravel, it will yield a building material proof for all time against fire and repairs.

WATER RESOURCES OF THE NORTHWEST.

The Geological Survey has recently issued a valuable publication concerning the surface water resources of the northwestern portion of the United States, the greater part of which is occupied by the basin of Columbia River. This river has a drainage area of 259,000 square miles. Its sources is in British Columbia and its basin occupies enormous areas in that province and in Montana, Wyoming, Idaho, Washington, Oregon and Nevada. The region is one of great interest and value. Few river basins in the country are so diverse. It contains some of the highest peaks in America and some of the most fertile valleys in the world. Some idea of the resources of the basin may be had from the statement that the navigable waters of the Columbia and its tributaries aggregate a length of 2,136 miles. Within the area drained are the largest forests in the world. The climate exhibits all the variations from the rigor of the northern latitude to the mildness of western Oregon and Washington. Agriculturally, the area ranges from the extremely arid region, where irrigation is essential, through the semi arid country, where dry farming and irrigation are practiced side by side, to the humid country, which, strictly speaking, is arid during the summer. The values of the irrigated agricultural land range from about \$30 an acre for the poorest to \$3,000 an acre for the intensively cultivated orchards. Within the Columbia River drainage basin are at least one-third of the available water powers in the United States, but development of this resource has scarcely begun.

The study of the water resources of this great region as carried on by the United States Geological Survey becomes therefore a matter of importance and interest. Water-Supply Paper 272, of the Survey, which has just been issued, contains a large amount of useful data resulting from the investigations of the streams of this area, including the records of flow of the numerous large tributaries as well as the main rivers. Among these tributaries are Clark Fork, which occupies large areas in Idaho, Montana and British Columbia, and Snake River, which has its origin in the Yellowstone Park region of Wyoming, traverses the southern portion of Idaho, and on its way drains large areas in Nevada. For a part of its course the Snake forms the boundary between Idaho and Oregon, and it traverses long distances in the State of Oregon before it finally joins the parent stream. In addition to stream-flow data concerning the Columbia, the report contains information concerning the water resources of the coastal streams, such as the Rogue, Umpqua and Siletz, located in Oregon, and the Cedar, Skagit and Cascade, which drain into Puget Sound. The stream-flow observations presented in this report consist of records obtained at 207 stations. About one-half of the expense of the work is borne by the States of Oregon, Washington, Idaho and Montana, which, under the authority of laws enacted by the several legislatures, co-operate with the United States Geological Survey in carrying on the work.

A copy of Water Supply Paper 272 may be had free on application to the Director of the United States Geological Survey, Washington, D. C.

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VARIETIES OF POTATOES AND HOW TO HANDLE THEM.*

BY MR. EDGERTON.

The potato question is something of vital importance. A good potato soil will produce any of the varieties grown in the world. You can grow anything in the potato line that the market demands.

The "Netted Gem" is one of the best varieties in Colorado. We can start picking the last week in August.

"Peachblow" will do to pick within two weeks after the "Netted Gem" if planted at the same time.

The "Burbank" potato requires more care in cultivation, irrigation, etc., than any other variety.

Conservation of moisture is worth everything in the world. It means a profit, or without it it means a loss, for you cannot supply it as well after it is gone.

Potatoes will not grow large if you practice close planting. If the soil is thin and you plant a long variety you will get a long, slim potato, which will not look natural and won't be salable, but the round potato will make a good growth if it is short of water.

The "Bliss Triumph" is one of the best potatoes for quality, and it will mature early. It is a good yielder under favorable conditions.

We haven't anything that will respond to treatment like potatoes.

Cultivation produces an even growth of potatoes.

For varieties I would select the "Pearl," "Netted Gem" and "Peachblow."

The "Idaho Rural" is the potato for Idaho.

You have got more land and more irrigation in Idaho than any other dozen states in the Union.

Put potatoes in the very best sack you can get in shipping. Use new sacks. New sacks cost about a half cent more than the others, and when they get into the car they will all look alike.

Put good potatoes in new sacks.

Buyers will tell you what kind of potatoes are liked in their respective communities. The white potato seems to sell the best out here.

Handle potatoes as cheaply and economically as possible.

I believe that within three or four miles of a siding you can grow potatoes under a system of irrigation mighty cheap.

When you grow potatoes go right at it just like the merchant goes about his business, because of competition.

It is important that potatoes be taken care of at digging time in the quickest possible manner.

I have seen potatoes sacked that were slopped all around. Get sacks plumb full of potatoes so that they will not slop around.

If potato vine is green and vigorous until time for frost, that is an indication of potatoes being free from disease.

Do not depend on hand work in growing potatoes for the market.

You will have to put potatoes on the car at 25 or 30 cents a hundred if you expect to make money.

The storing of potatoes is a mighty important thing. Store seed in a cold place.

Sunshine is almost a sure cure for rot. Give potatoes a sunning before planting, about a week before cutting and planting.

Three men should keep a planter going.

Build cellars with currents of air in order to give complete circulation.

In building cellars arrange them to drive through.

A cellar is a splendid thing to keep a planter in, so make it good and large.

The Robbins planter is the best machine to use for planting.

The Douden digger is a very strong machine and will stand lots of abuse.

For a 20-acre field my idea is to get acreage the same and keep it the same year after year, then I don't waste a lot of storage room one year.

Make cellar about 70 to 100 feet long and 32 to 36 feet wide. Use timbers instead of planking.

Go in ground about 4 feet and out of ground up to eaves 3 feet. Use willows on roof if it is possible to get them.

(Continued on page 228.)

*From Bulletin No. 1, Movable Schools of Agriculture, University of Idaho, issued by the Hub City Irrigationist, Wendell, Idaho.

A KEROSENE MOTOR FOR IRRIGATION

By Raymond Olney.

A large and rapidly growing percentage of irrigation farmers in the United States have to depend upon isolated pumping plants to supply the water needed for their crops. These plants are used to pump water either from streams or wells.

The well-and-pump system is considered the best system and the one most generally used. It is to be found in use particularly in the rice fields of Texas, Louisiana and Arkansas. The water from these wells is soft and fresh, and has a constant temperature of about 70 degrees Fahrenheit, which insures good growing conditions for the rice plant. The water thus obtained is free from harmful weed seeds, which often come to the land in the flood waters.

One of the big problems in connection with the mechanical lifting of water is power. The successful operation of any pumping plant will depend very largely upon the kind of power used. Reliability, capacity and low cost of operation should be the deciding factors in the selection of the power unit.

The two forms of power most generally used are steam and internal combustion engines. In the past the steam engines have been favored because of the lack of reliable gasoline engines. At the present time, however, steam is rapidly being superseded.

The increasing demand for gasoline and the large surplus production of kerosene are the means of turning the attention of certain manufacturers to the development of a kerosene burning engine. This condition of affairs is being taken advantage of by the M. Rumely Company, 1741 Main street, La Porte, Indiana. This company is building an internal combustion engine which is known as the Oil-Pull "E" Motor. It is the same motor which is used on their Oil-Pull Type "E" Tractor.

It has a rated capacity of 60 brake horsepower. In actual tests, when running at about two-thirds load, it has delivered 2,000 gallons of water per minute from a well with a 40 foot lift. It will ordinarily flood from 200 to 400 acres. In cases where a number of wells can be united and run by one pump, it is possible to flood 500 to 600 acres.

This motor burns kerosene or distillate, economically at all loads and under all climatic conditions. The Secor-Higgins principle of carburetion, which is used, makes it a most successful kerosene-burning engine.

The fact that the price of kerosene is steadily growing cheaper is the means of placing the kerosene motor in strong competition with the steam and gasoline types. The table given herewith was reproduced from results obtained by a Government investigation conducted in 1910 by Prof. W. B. Gregory of Tulane University. It was assumed in the report that each pumping plant was operated 80 days per season for 24 hours per day, or 1,920 hours. The figures given here show the total cost of fuel per brake horsepower for the entire season of steam and gasoline as compared to kerosene. The Oil-Pull "E" Motor was not included in the work carried on by Prof. Gregory. The data are given here merely for comparison.

Cost of fuel for a season of 80 days per brake horsepower:

COST OF FUEL FOR A SEASON OF 80 DAYS PER BRAKE HORSEPOWER.

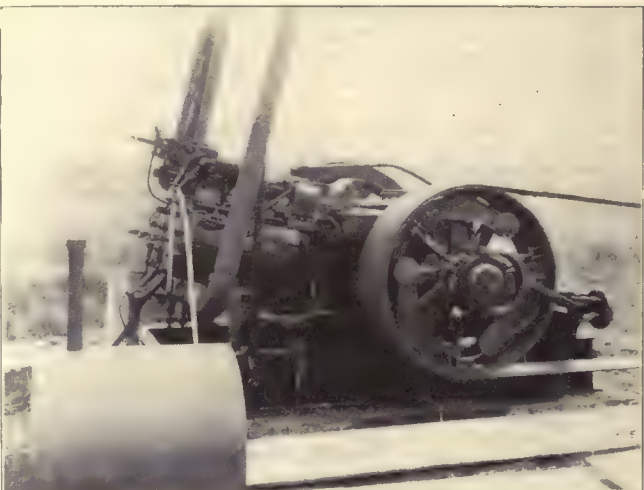
Brake Horsepower of engine.	TYPE OF ENGINE.									
	Simple		Compound non- condensing		Compound condensing		Gasoline		60 b. h. p. Type "E" Motor	
	Coal per ton		Coal per ton		Coal per ton		Gasoline per gallon.		Kerosene per gallon.	
	\$4	\$6	\$4	\$6	\$4	\$6	10c	15c	5c	7c
30	\$22.45	\$33.70	\$13.50	\$20.20	\$11.80	\$17.70	\$24.00	\$36.00		
50	22.50	33.70	13.50	20.30	11.80	17.70	24.00	36.00		
70	22.50	33.80	13.52	20.35	11.80	17.65	24.00	36.00		
100	22.48	33.72	13.50	22.25	11.80	17.70	.....	.....
Average	22.48	33.73	13.50	20.27	11.80	17.69	24.00	36.00	10.42	14.58

At Uvalde, Texas, this motor is used to drive an 8 inch double suction pump, delivering 2,000 to 2,300 gallons per minute against a total head of 82 feet. A cheap grade of kerosene is used costing 7 cents per gallon. The engine consumes 5 gallons per hour.



Oil Pull "E" Motor Pumping 2,000 Gallons Per Minute.

It is found that a minimum amount of attention is required for operation. The regulation of the power plant is automatic, which enables the operator to give a greater part of his time to other work. This simplicity of operation of the kerosene burning engine gives it a decided advantage



Oil Pull "E" Motor.

over other forms of power. Where the steam engine is used, it is necessary for the operator to be in constant attendance.

CORRESPONDENCE

AN IRRIGATION PROBLEM IN OKLAHOMA.

Chicago, Ill.

IRRIGATION AGE Publishing Company,

Gents:— I am going to install an irrigation plant and I inclose a blue print of same.

I wish some advice in the matter—and I will appreciate any information you may be able to give me in regard to same. Now if you are not familiar with irrigation conditions in the southwest maybe you can refer me to some one who knows.

I have a lift of 18 feet out of river flowing 40 to 50 second feet and I have the first water right. From the river east there is a fall of three feet in one-quarter of a mile. Down the river there is enough fall to run water in ditch parallel to river bank. The river overflows about one to three feet in places, but there is little current and a high foundation would take care of a stationary engine.

I will have to arrange to take care of the west side of the river and I would like to do so with one pump. The banks are 40 ft. across. Land slopes from river. Now I wish to know will it be best to install a stationary engine and a large pump, say No. 10 centrifugal, or had I better install a portable one and use two pumps, one lower down the river?

What kind of engine (oil or gasoline) must I install? I can buy good oil at 75 cents per barrel and a cheap gasoline at 9½ cents per gallon at Foss.

I have already installed an International Harvester, 35 h. p. gasoline stationary engine and a No. 10 Gould centrifugal pump on a place lower down the river to irrigate 200 acres of alfalfa. I have not tested the engine fully on account of my main ditches being too small to carry the water.

The company guarantees to lift 3,000 gallons per minute a height of 20 feet. I would like to get my second place ready as soon as possible for next year's crop.

Our alfalfa needs moisture in March, so I must get busy. You can return my blue print.

Thanking you for favor, I am, sir,

Yours truly,

W. F. CANTELOU.

[Editor's Note.—This problem was submitted to Mr. R. C. Wise, mechanical engineer of the Henion and Hubbell Co. of Chicago, who has made a thorough study of the situation and whose answer has been forwarded to Mr. Cantelou some time ago. But the whole problem is of such general interest that we had a cut made of the map and present the complete analysis to our readers at this time.]

THE ANSWER ANALYZING THE PROBLEM.

THE IRRIGATION AGE,

Mr. D. H. Anderson, Publisher,

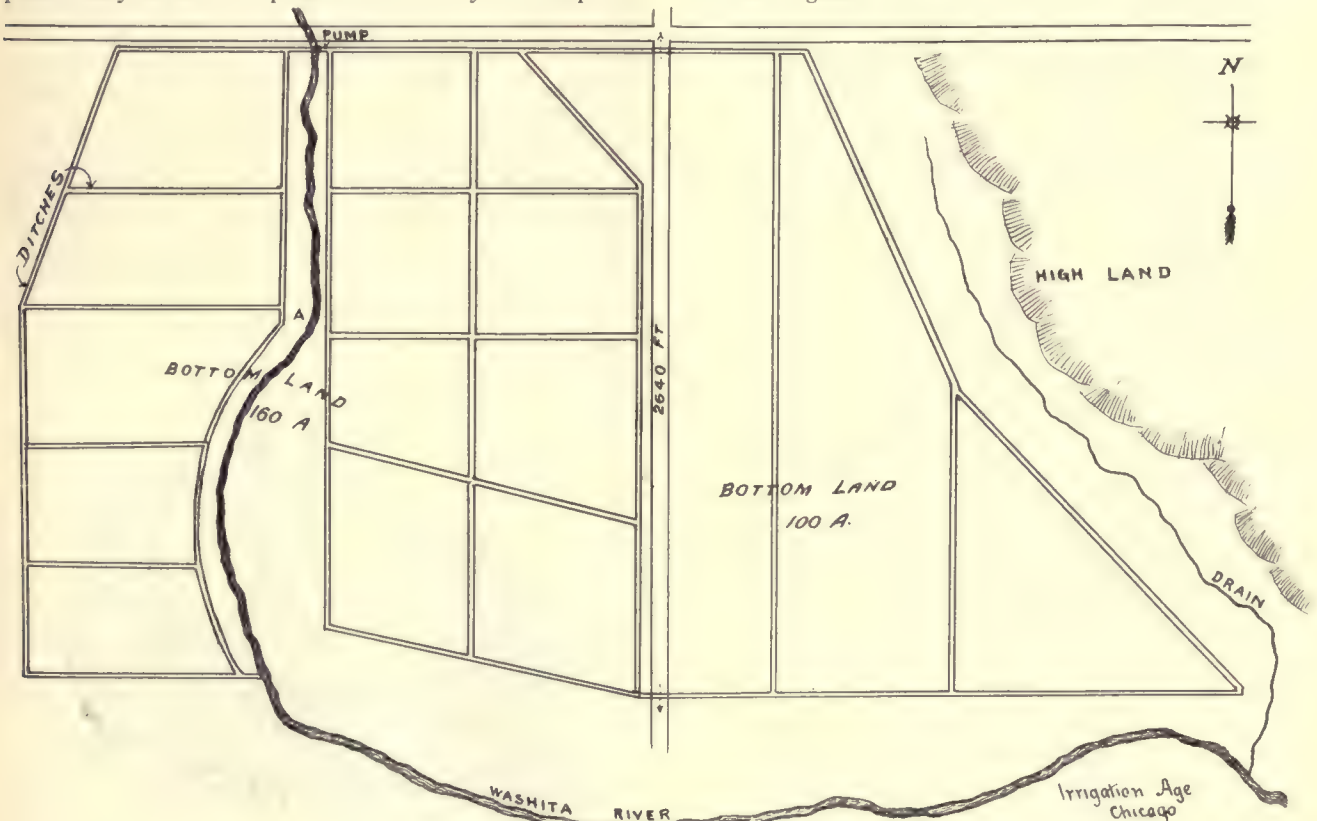
30 North Dearborn St., Chicago, Ill.

We note correspondence and data which you have referred to us from Mr. W. F. Cantelou, Foss, Okla., in regard to pumping water for irrigating a plat of land, as per blue-print of the survey, also at hand (see accompanying sketch).

As situated, the Washita River divides the land in two parts, on a rough north and south line. The part west of the river is a long, narrow strip, about 40 to 60 rods wide, and a half mile long, and comprises apparently about 40 acres, to be irrigated. The part east of the river, according to the plat, consists of bottom lands and some uplands, including in which is about 200 acres to be irrigated.

The river flows in a general southerly direction, making a wide turn around the southwestern corner of the large eastern portion of the land. We presume it borders on Mr. Cantelou's land all the way, making roughly 1½ miles of river bank around this part of the land.

Judging from the location marked on the plat for the pump, this is probably the highest point of the land, and is at the northern line. From there the land seems to gradually slope away toward the farther corner of the eastern section, and also toward the southern portion of the western section. Mr. Cantelou states that there is a fall of three feet in ¼-mile down the river. No doubt the general fall in the land is about the same, which would be ample fall for ditching. Both parcels of the land, that is, on each side of the river, are to be irrigated.



Plat of Land to be Irrigated.

As a general rule, it is impractical to pipe across an open stream, unless absolutely necessary, on account of flood conditions, cost of foundations, etc. Unless this could be done, the pumping must be divided. However, the details in regard to the possibility of piping across the river are not at hand. We assume, in the absence of further information, that separate provision will be made for each side of the river, calling for at least two pumping outfits; of these the one for the east side would be the larger.

As to size of pump to use, Mr. Cantelou speaks of having a No. 10 Gould centrifugal pump with a 30 H. P. Gasoline on another plat, further down the river, irrigating alfalfa. This seems to suit him as to size pretty well.

However, in view of the necessity of having at least two pumping outfits for this land, we would suggest the use of a No. 8 Morris Centrifugal pump for the east side of the river and a No. 6 for the west side. The No. 8 Morris Centrifugal pump operating at its normal capacity of 2,000 gallons per minute, would cover in 10 hours, one inch deep, a theoretical area of 44 acres; the No. 6, at 1,000 gallons per minute, 22 acres. These figures do not include waste, percolation, seepage, evaporation, etc.

The location of the pumping outfits ought to be carefully considered.

In order to operate most economically, the pumping should be done where the elevation to be overcome will be the least possible, and still deliver the water where needed. This brings into account the relative elevations of the stream, and the profile of the land surrounding it. We suspect there is a gradual drop in the land from the north line southward, which leads to the question, as to whether it would not be better to move the pumping plant southward as far as possible. There appears to be a good point about $\frac{1}{4}$ -mile south of the north line, indicated by the letter A, where the river begins to make a wide bend.

To overcome the rise in the land north of this point, have the banks of the ditches raised sufficiently so that the water will be carried north as far as wanted. Suitable gating arrangements can be provided at the pump discharge so that the water will be forced north when needed. Then when pumping for points south of this, which would cover perhaps two-thirds of the land, the lift would be several feet less and the work done with that much better economy. If three or four feet could be taken off the pumping head by this means, it would save from one-fourth to one-third in the cost of fuel for that particular service.

Mr. Cantelou asks about a portable outfit. A portable outfit properly located will do the same work with greater economy because it can be located at the point where the pumping head is the least. It can also serve portions which would otherwise not be thoroughly irrigated, and would make the problem of ditching and cleaning ditches easier. Besides this it can be used for other purposes. It would undoubtedly be a good investment.

A portable outfit with a No. 6 pump could serve the small western portion of the land and then be moved across the river to help out the No. 8. The two combined would have the same normal capacity as a No. 10, with the advantage of better distribution of water.

We think that Mr. Cantelou should use *one* No. 8 Morris Centrifugal pump, stationary, and *one* No. 6 Morris pump as a portable outfit on trucks, or else that he should use *three* stationary outfits, consisting of one No. 8 and two No. 6 pumps, with engines for each. The additional stationary outfit to be so located as to serve the farther portion of the east side of the river where the lift is probably low, and where the water would not be required to flow through such a large amount of ditching.

The No. 8 Morris Improved Standard Horizontal Right Hand Centrifugal pump, with belt pulley and hand primer, should be used for the main stationary outfit in either case. It has 8-inch discharge and 10-inch suction connections, weighs 2,430 pounds and has 20x12 pulley. The speed on 15 foot total head, including friction allowance through piping, is 250 revolutions per minute; on 20 foot head 293 revolutions per minute.

10-inch piping should be used on both suction and discharge. This will make pumping conditions easier. It also

has the additional advantage of making it possible to interchange piping at any time.

In order to understand this No. 8 Morris pump properly would say that the shell is about the same or larger than the Gould No. 10, which Mr. Cantelou has and contains about the same amount of metal in its vital parts. No doubt Mr. Cantelou would consider it another No. 10 pump. It has the enclosed runner or piston which wears better than the "open" wing pumping dirty or gritty water, which is usual in irrigation streams. The runner is large, with large waterways, thereby causing it to operate at slower speeds, and with less mechanical troubles than is usual. The "enclosed" runner usually maintains efficiency better, i. e., after prolonged service, the effect of wear is less.

To operate this pump we suggest a 25 H. P. Venn-Severin kerosene or fuel oil engine with belt pulley. This engine will provide a considerable margin of power, of which full use may be made. The normal speed delivering 25 H. P. is about 275 revolutions per minute. If the pulleys are so proportioned that the pump will run at catalogued speed for the head, when the engine is running about 230 revolutions, there will be 45 revolutions per minute of increase, which may be added by adjusting the governor springs. By increasing the speed of the pump and engine, from 30 to 50 per cent may be added to the capacity of the pump if needed, and this should require about the full power of the engine. This is the way to get good service from this outfit.

The price of the above pump and engine, f. o. b. cars Chicago, is estimated at \$983.50.

If the pumping plant can be so arranged that the actual pumping head, including friction, is between 15 and 16 feet, then a No. 10 Morris Centrifugal pump could be used—capacity 3,000 gallons per minute—which would make the outfit cost about \$40 more. 12-inch piping should be used on both suction and discharge.

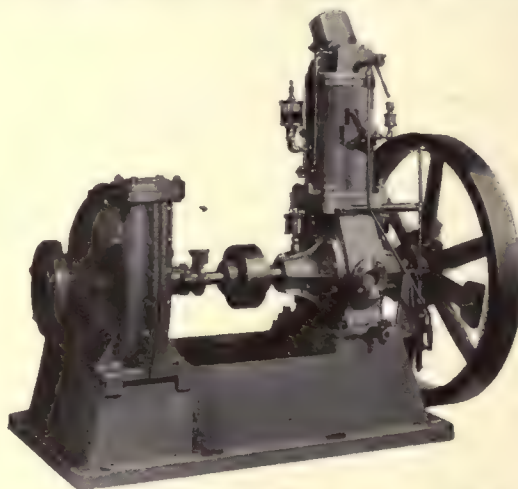
12-inch rubber belting, 4-ply, of the best quality, known as "Extra" (sold with a guarantee), for No. 6, No. 8, or No. 10 pumps costs 76 cents per foot. If made endless, 3 feet is added for splicing. On account of the long running hours, only the best belting should be used.

It is often preferred to have a directly connected outfit. It would be practical here to have the No. 8 Morris pump directly connected to the 25 H. P. kerosene engine, having both placed on the same base, and connected on the same shaft, doing away with belting, and making the outfit more compact (see appended illustration). The pumping head in this case would be fixed by the speed of the engine. At 275 revolutions per minute the outfit would operate against about 17½ foot head.

The cost of this direct connected outfit, f. o. b. cars Chicago, is \$985.00.

Regarding the No. 6 Stationary outfit, this would include a Morris centrifugal pump, with hand primer, as per appended cut, 6-inch discharge, 8-inch suction, which, under 15 foot total head, runs 295 revolutions per minute, and under 20 foot 341 revolutions per minute, and has 15x12 belt pulley. 8-inch piping should be used on both suction and discharge. Pump weighs about 1,345 pounds.

To operate this pump we suggest a 10 H. P. Venn-Severin



Morris Centrifugal Pump Directly Connected to Engine.

The Primer of Hydraulics is Now Ready

engine for kerosene or fuel oil. Price of above pump and engine, with usual trimmings, \$508.00.

This outfit should be used where the head, including pipe friction, does not exceed 17 feet. Nevertheless, the pump usually does better than catalogue rating, and engine also can be varied in speed.

This engine and pump can also be arranged directly connected on same sub-base. Estimate, \$514.00.

To make the portable outfit previously referred to, a No. 6 Morris Centrifugal pump is suggested with the above Venn-Severin 10 H. P. engine, directly connected, which should be mounted on heavy trucks, with tongue, whiffle-trees, etc., for hauling by team. Tanks to be provided for the engine. Wide-tired wheels to be used, and the whole mounted low so that it can be lowered to the ground without difficulty, or supported by jacks, while running. Estimate of engine, pump, trucks, and mountings complete, \$680.00.

10 feet of 8-inch smooth bore "Best Grade" suction hose, having wire ribbing in the fabric of the hose, and iron pipe connections wired in each end, would cost about \$93.00 net. This would be needed with the portable outfit for allowing the pipe to be shifted to suit conditions.

As to piping for the Stationary No. 6 or No. 8 pumps, would say it is difficult to figure correctly without having laid out the whole plant. It would probably be about as follows:

For the No. 8 pump:

Three 10-foot lengths 10-inch No. 16 gauge spiral riveted flanged and asphalted pipe.

Two 5-foot lengths, same.

Three 10" 45-degree flanged elbows.

Bolts and gaskets.

Price, \$84.40.

A similar list of 8-inch piping for the No. 6 pump would cost \$63.75.

Twenty-foot lengths might be needed for the No. 6 portable, which would cost each, with bolts and gaskets, \$14.65.

Two extra 8-inch threaded companion flanges, \$3.80.

Twelve-inch pipe for the No. 10 outfit would cost about 25 per cent more than for the No. 8.

From the data herein given, Mr. Cantelou can, we believe, make a selection that will suit his exact needs.

The estimates given are on outfits, which we believe will give the most per dollar,—not necessarily the cheapest in first cost nor the highest,—but such as will *make the dollar work at its highest efficiency*. It is not alone the amount paid, but the value received in materials, workmanship and service which makes a "bargain."

The progress of irrigation pumping is suffering a great deal by the effort to get good machinery at the cost of poor. The result finally is that trouble originates, from some one of the numerous defects to which such apparatus is subject. It develops unexpectedly. Lack of water may mean ruin. The extra shut-down and delay is usually worth more, several times over to the irrigator, than the extra cost of the better machinery.

The question is raised as to fuel. Mr. Cantelou states that he can buy crude oil with asphaltum base, or "solar" oil cost 3 cents per gallon, or gasoline and naphtha, 9½ cents per gallon.

Regarding this would say that oil with an asphaltum base is not successful with these engines. It must be oil with the paraffine base. Some grades of crude oil are suitable. We understand that oils from Tulsa or Muskogee are the best in that region. The usual oil for these engines is called "fuel" oil.

The figures on fuel economy are interesting.

Take the case of solar oil, costing 3 cents per gallon, and gasoline at 9½ cents per gallon. The saving is 6½ cents per gallon. The Venn-Severin engines develop from 8 to 10 H. P. per gallon per hour. The manufacturers guarantee them to do better than one pint per horse power per hour. On the basis of saving 6½ cents per gallon, the total saving in one pumping season of 90 days, 12 hours per day, would be about \$210.00.

This is about the difference in cost between a standard gasoline engine and a crude-oil kerosene, or solar oil engine, such as we are estimating. In four seasons of pumping the first cost of the engine would nearly be returned, out of the saving in fuel alone; in five seasons more than returned.

The life of the outfit, with reasonable care, should be more than this. Therefore the figures on fuel saving mean

simply that one *could not accept as a free gift* an ordinary gasoline engine, under these circumstances.

Yours very truly,

HENTON & HUBBELL,
Per R. C. Wise,
Mechanical Engineer.

WANTS INFORMATION ON WELLS.

Mr. D. H. Anderson, Publisher,
IRRIGATION AGE.

I have been reading your paper and I am very much interested. I am digging a well for irrigation and I want to ask you if you can give me any information in regard to the construction of the well. The water is 20 feet below the earth surface, and the gravel is seven feet thick. It is the only one in the country of its kind.

Mr. McGillon, of Omaha, is very much interested in irrigation from wells also. If you can give any advice in regard to this work I would be very thankful for the same.

Yours very sincerely,

WALTER E. WILLIAMS.

Perhaps some of our readers in Colorado who have similar experiences can give Mr. Williams the desired information.—Editor.

SOME VALUABLE INFORMATION FREE.

Milwaukee, U. S. A., March 29, 1912.

Mr. D. H. Anderson, Publisher,
IRRIGATION AGE.

Dear Sir:—For the news items of your publication, we wish to state that we will have ready for distribution within a few days, our new catalog No. 12 fully illustrating our line of engines from 2½ to 30 h. p. and up.

We will also mail to the readers of your paper, upon request, our engineering course, educating them in the care and operation of an engine, consisting of three lessons as follows:

1st—How to Operate an Engine.

2nd—Installation of Model Power House on Farm.

3rd—Viscosity of oil, density and gravity of gasoline, how to figure H. P. and various other technical information and tables.

These lessons are very valuable to a dealer as well as the consumer and we shall be pleased to send them free of charge to anyone inquiring for them through your paper.

Yours very truly,

THE CHRISTENSEN ENGINEERING CO.

We hope that a great many of our readers will make use of this kind offer of the Christensen Engineering Co. of Milwaukee and write for the new catalogue as well as for the engineering course, which is offered free of charge.—Editor.

SOME INTERESTING COMMENT.

Wendell, Idaho, Feb. 29, 1912.

D. H. Anderson, Pub., THE IRRIGATION AGE, Chicago, Ill.

I have noted the editorial relating to my "Corn" story, and quite agree with you that what is desired is an expression from the practical man on the practical ways of doing things. I have done considerable newspaper and magazine work along with my practical experience, and it has always been a source of grief to me that more practical articles do not appear. I have suggested to our local papers that they make a campaign for practical information, going right after the practical man, but they do not seem to fall in line.

I intend to give you articles from time to time, as I am always on the lookout myself for good information.

The enclosed bulletin might be of some interest to you. If there is any information in it which you can use, and will use, kindly give myself and the "Irrigationist" proper credit.

Thanking you again for your kindness in publishing the corn story, and for the editorial which accompanied it, believe me,

Very truly yours,

HELEN-MAE RANCH,

By Frank S. Reid.

We desire to thank Mr. Reid for his interesting remarks and for the bulletin forwarded to us; we shall endeavor to use some of the practical ideas contained therein.—Editor.

THE PRIMER OF HYDRAULICS*

By FREDERICK A. SMITH, C. E.

Article XVIII. Loss of Head at Entrance to Pipes.

If a pipe projects into a tank or reservoir there is a loss

of head due to the entrance equal to $L = \frac{v^2}{2g}$; if the pipe does not project the loss of head is just $L = \frac{v^2}{4g}$ or just half of

the former; in this formula L = loss of head in ft., v = mean velocity in pipe and $g = 32.16$. This loss is small and is usually neglected except for great velocities. Thus if $v = 4$ ft. the loss = .25 for pipes extending into the reservoir and .125 ft. for pipes just opening into the reservoir. Should the velocity, however, reach 8 ft. per second then the loss of head in the first case would be 1 ft. and in the second $\frac{1}{2}$ ft., quite appreciable quantities which grow as the square of the velocity. Hence, for high velocities the entrance of pipes into tanks should be made flaring, as indicated in figure

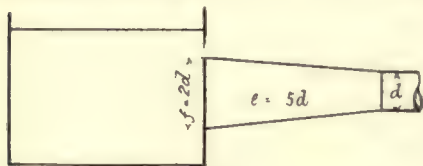


Fig. 95.

95. A good proportion for the enlargement when d = diameter of pipe, make $e = 5d$ and $f = 2d$.

1. General Remarks.

The commonest artificial hydraulic channel is the ditch, and the knowledge regarding proper construction is very limited. Yet the adaptability of this kind of channel is very great and is becoming more important on account of the increased use of ditches in irrigation work. For clean, well cut ditches a factor of roughness of .025 is recommended, though for particularly smooth work .020 may be found correct. For rougher work where there are noticeable changes in cross section and grade n should be taken .030 and for ditches that are very irregular and rough in line grade and finish with obstructions to the flow the factor n should be taken .035 to .040 and according to aggravated condition the factor may even have to be taken still greater.

2. Triangular Ditches.

The forms of ditches are generally either triangular, rectangular or trapezoidal, the hydraulic principles of which forms have been analyzed in IX-4. In Figs. 96, 97 and 98 are shown typical sections of triangular ditches; Fig. 96 shows side slopes 1 to 1, Fig. 97 shows slopes $1\frac{1}{2}$ to 1 and Fig. 98 shows a slope of 1 to 1 on the left and a slope of $1\frac{1}{2}$ to 1 on the right side. They are all easily analyzed as regards their hydraulic properties. The triangle ABC in Fig. 96 is right angled and if the line CD is drawn perpendicular to AB then $CD = AD$ and the area of $ABC = AD \times DC$. Call $DC = d$ the area $ABC = d^2$, which represents the flow area in such a triangular ditch with a depth of flow of d . The wetted perimeter = $AC + BC$ $AC = \sqrt{2d^2} = d\sqrt{2}$, hence let P = wetted perimeter, then $P = 2d\sqrt{2} = 2.828d$.

From which it follows that $r = \frac{d^2}{2.828d} = d \div 2.828 = .353d$. From this the \sqrt{r} is easily computed or looked up in the table and the factor C is then found in the tables, reference being had to the slope and the coefficient of roughness as indicated in the preceding paragraph.

In designing ditches it must be remembered that the velocity of the expected flow has to be well considered as the velocity may become too great and destroy the ditch by erosion. Here the hydraulic engineer must use good judgment and if the material of the ditch is easily pitted by the current, then the velocity of the current must be reduced by decreasing the slope and increase the cross section so as to get the required capacity.

If this, however, cannot be done the ditch must be lined

either with concrete, boards or paving, in which case the size of the ditch may be reduced, as the smooth lining decreases the resistance to flow and the factor n may be used of a lower value according to the smoothness of the lining.

For the case shown in Figure 97 the area:

$$a = d \times 1.5d = 1.5d^2 \text{ and the wetted perimeter } p = 2\sqrt{d^2 + 1.5^2d^2} = 2\sqrt{d^2(1 + 2.25)} = 2\sqrt{3.25}d = 3.606d, \text{ hence } r = \frac{1.5d^2}{3.606d} = .415d.$$

Fig. 97.

For the case shown in Fig. 98, $a = \frac{1.5d^2}{2} + \frac{d^2}{2} = \frac{2.5d^2}{2} = 1.25d^2$; $p = 1.803d + 1.414d = 3.217d$, hence $r = 1.25d^2 \div 3.217d = .387d$ —so when the depth of flow is given, a , p and r can be readily computed.

3. Rectangular Ditches.

In Fig. 99 is shown a typical section of a rectangular ditch $ABCD$ in which BC , is the width, and AB , the height—let $BC = b$ and $AB = d$ then bd = flow area and $b + 2d$ = wetted peri-

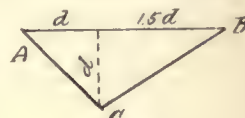


Fig. 98.

$$\text{meter; hence } r = \frac{bd}{b + 2d}$$

from which the factor C can be found.

Ditches of this cross section are not practicable except in stone cutting or where the ditch is lined with masonry or lumber.

4. Trapezoidal Ditches.

Fig. 100 shows a ditch with slopes $\frac{1}{2}$ to 1, Fig. 101 shows slopes 1 to 1, Fig. 102 shows slopes $1\frac{1}{2}$ to 1 and Fig. 103 shows slopes 2 to 1. The hydraulic radius is easily computed for each case; let b be the width of base and d the depth of flow in

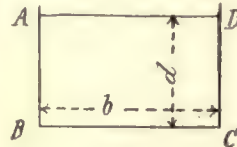


Fig. 99.

each case, then for Fig. 100 the flow area $a = bd + \frac{d^2}{2} = \frac{(2b + d)d}{2}$; the wetted perimeter = $b + d\sqrt{3}$, hence the

$$\text{hydraulic radius } r = \frac{d}{2}(2b + d) \div b + 1.7321d.$$

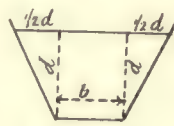


Fig. 100.

In Fig. 101 the flow area $a = bd + d^2 = d(b + d)$, the wetted perimeter = $b + 2d\sqrt{2} = b + 2.828d$, hence $r = d(b + d) \div b + 2.828d$.

In Fig. 102 flow area $a = bd + 1.5d^2 = d(b + 1.5d)$. The wetted perimeter = $b + 2\sqrt{2.25d^2 + d^2} = b + 3.606d$. In Fig. 103 the flow area $a = bd + 2d^2 = d(b + 2d)$. The wetted perimeter = $b + 4.4722d$, the hydraulic radius $r = d(b + 2d) \div b + 4.4722d$.

In case the slopes should be not symmetrical as indicated in Fig. 104, having a 1 to 1 slope on the left and a $1\frac{1}{2}$ to 1 on the right. This should be treated as shown in Art. XIX. (See Fig. 98.) The flow area $a =$

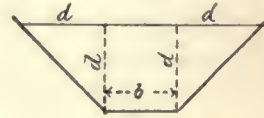


Fig. 101.

$$bd + \frac{d^2}{2} + \frac{3}{4}d^2 = \frac{4bd}{4} + \frac{2d^2}{4} + \frac{3d^2}{4} = \frac{4bd + 5d^2}{4}$$

$$r = \frac{d}{4}(4b + 5d).$$

The wetted perimeter = $b + d\sqrt{2} + d\sqrt{3.25} = b + d(\sqrt{2} + \sqrt{3.25}) = b + d(1.4142 + 1.8030) = b + 3.2452d$.

$$\text{Then the hydraulic radius } r = \frac{d}{4}(4b + 5d) \div b + 3.2452d.$$

Reclamation Notes

CALIFORNIA.

Well drilling operations at the Magee Ranch at Las Flores have resulting in getting a flow of 110 inches from a 15-inch hole on a tract west of the ranch house. This will be used to irrigate 250 acres of sugar beets.

Well No. 7 of the Beaumont Land & Water Company, which was sunk last November, was tested recently and found to maintain a flow, under continuous pumping, of 55 inches. The pump, which is a 14-inch centrifugal, has only recently been installed. The well is located about six miles north of Beaumont, in the Edgar canyon, and is 961 feet deep.

The project of Crescent Reclamation district to levy an assessment of \$8,855.74 for additional levee work has been approved by the supervisors.

Property owners near Coalinga and members of the irrigation committee of the Coalinga Chamber of Commerce held a meeting recently at which plans were discussed for the movement which they hope to start to get government aid for the big irrigation project which has been promulgated. No definite plans have yet been outlined and until they are it is said that nothing will be made public.

A plan for the relief of the homesteaders under the Uma reclamation project has been perfected by the government, and will go into effect within a month. Under the old project each settler must pay within ten years \$55 an acre for his land in annual installments of \$5.50 per acre. The second annual payment was due March 15, and a large number of the settlers claimed that it was impossible to meet the payment because the crops would not be ready for harvesting until the middle of April. The new plan increases the price of the land to \$65 per acre. The annual installments, however, are small. It is provided that the first payment shall be \$5.50 per acre; the second, \$1; third, \$2; fourth, \$3.50; fifth, \$5; sixth, \$7; seventh, \$9; eighth, \$10; ninth, \$11, and tenth, \$12.

The Southland Nurseries of Terra Bella will install an overhead irrigation system to cover the forty acres of land included in its holdings. It is planned to start work within a few months, equipping ten acres on the start.

The Utah Construction Company, which is building the 300 miles of canals and laterals for the Oakdale Irrigation District, has had to suspend work on six tunnels in division 1 of the canyon of the Stanislaus river, owing to the hardness of the rock. They are installing electric power and will use compressed air to drill holes for the powder. This section is the only one on the ditch where the work is standing still; the other work is progressing in a satisfactory manner. On the line of the Oakdale ditch is one tunnel 7,000 feet long—the longest tunnel ever built for irrigation purposes.

Seattle capitalists have purchased 2,000 acres of land in Yuba county in Brown's valley belonging to C. C. Finne-more and A. J. Brady of Marysville. The land has been used for pasture purposes, but will now be irrigated and colonized.

Surveyors are now platting the South San Joaquin irrigation district. The surveys will show the grade and the high and low places so that a man will know just where to locate his alfalfa patch or orchard so that the water will be utilized to the best advantage. A large storage reservoir, known as the Woodward reservoir, covering 1,400 acres, is one of the important features of the South San Joaquin district. This reservoir is located near Eugene and is fed by the Littlejohn and other small creeks.

William Newport of Perris is installing a 60 horse-power pumping plant on his Menifee ranch south of that city. The seventh well on the ranch has been completed and Mr. Newport is confident that he will have an abundant water supply to irrigate a large acreage of alfalfa.

The Kuhn irrigation project in Glenn and Colusa counties is completed and water has been turned into the system for irrigation purposes. This project embraces more than a quarter of a million acres.

At a meeting of the stockholders of the Enterprise Canal & Irrigation Company, held in Fresno recently, the property was deeded to the Fresno Canal & Irrigation Company.

The San Joaquin & Kings River Canal & Irrigation Company, whose principal place of business is Carson City, Nev., has filed a certified copy of a certificate of amendment to its original articles of incorporation. The capital stock of the company is \$1,000,000 divided into 100,000 shares of a par value of \$10 each.

COLORADO.

The completion of the North Sterling irrigation reservoir at Point of Rocks puts Sterling and Logan counties in line to cope with any other irrigated section in the entire country. Eight thousand acres of fertile land will be brought under cultivation. The approximate cost of the project is \$2,800,000. The dam is one mile long and 87 feet high.

D. A. Camfield, of Denver, president of the construction company who are building the Greeley-Poudre irrigation system, is authority for the statement that the system will be completed by the middle of this month and that water will be flowing through the Laramie-Poudre tunnel by May 1.

The concreting in place of hoists and gates of the Montrose and Delta canal headworks was commenced and the eight canal gates were set during the past month. The installation of a new concrete floor in the Gunnison tunnel was completed for a distance of 3,831 linear feet.

The San Luis Land, Light & Power Company, composed of Colorado and eastern parties, has been organized to take over the irrigation properties of the seaman Syndicate in the Terrace District of Conejos county. The construction of 30 miles of canals and laterals, reservoirs and dams will be carried to completion at an approximate cost of \$2,000,000. The contract for the work has been let to Anderson, Orde & Swope of Denver. The project when completed in 1913 will serve to furnish water to 34,000 acres of land in the vicinity of La Jara. Water for irrigation will be taken from the Alamosa river.

Application has been made for a receiver for the various companies interested in the construction of the Sunnyside irrigation system, which was to water 25,000 acres of land near Du Beque. Charges are made against Denver men who were to have built the system.

The Park Land & Irrigation Company of Grand Junction has purchased 3,920 acres of land lying near Grand Junction, owned by Thatcher Bros., of Pueblo, for a consideration, it is stated, of \$40,000. The tract lies on what is known as Pinon Mesa and the Westwater country. Sixteen hundred acres of the 3,920 acres is irrigable land, and 700 acres are already under cultivation. This 1,600 acres will be retained by the company and will be divided into small tracts and sold. The tract will be watered from the Big Park irrigation system.

The Indorado Realty Company, of Vincennes, Ind., has purchased the Dupont tract, consisting of 6,220 acres lying under the new Pueblo county municipal irrigation district, 12 miles west of Pueblo. The consideration is \$600,000. The new purchasers will divide the land into five and ten-acre tracts to sell to eastern farmers. Office.

of the company will be established in Pueblo and a colonization campaign launched in the near future, when the entire body of land will be placed on the market.

IDAHO.

J. C. Weeter, of Pocatello, is authority for the statement that the Bruneau irrigation project in southern Idaho has been financed, but that the company hesitates to commence work at once for fear that the bringing of so much land under water at one time would swamp the land market in Idaho, since there are so many projects in the state in course of construction. The main canal for this project will lead from Snake river at American Falls and circle the foothills a distance of 150 miles before it reaches the Bruneau tract. This project, when completed, will be the largest in the United States, comprising nearly 600,000 acres.

The Supreme court has confirmed the bond issue of \$7,134,638.05 voted by the settlers of the Black Canyon irrigation district and the bonds will be disposed of immediately to responsible bonding houses who are anxious to handle them.

The Secretary of the Interior has authorized the Director of the Reclamation Service to issue advertisements calling for proposals for 260,000 barrels of Portland cement for delivery during the years 1913, 1914, 1915 and 1916, for use in the construction of the Arrowrock dam on the Boise irrigation project. A contract covering the whole period will obviate considerable work incident upon advertising, awarding and executing contracts each year. In addition to this, the use of one brand of cement for the entire structure would be advantageous in that a greater uniformity of result could be secured and the men on the work would become so accustomed to the characteristics of the material as to enable them to make a greater rate of progress.

The Reclamation Service is preparing to install a plant for the blending of sand and cement at the Arrowrock dam. This plant will have a daily capacity of 1,000 barrels of 40 per cent blend sand and cement and will cost approximately \$40,000.

The State Supreme court, in the case of Virginia A. Haynes vs. The Idaho Irrigation Company, holds the defendant liable for damages in having failed to deliver water on the plaintiff settler's land by the date named in the contract or for the irrigation season of 1909.

Edgar L. and Estelle Montgomery have sold to the State of Idaho their interest in the West Side irrigation ditch, and the water conducted thereby from the Big Lost river.

It is stated that C. J. McCormick, of Pasadena, Cal., will take over the bonds of the Snake River Irrigation Company, which is reclaiming 2,600 acres of land in Dead Ox Flat, just south of Weiser. The bond issue amounts to \$48,000, which is to say that it will cost \$18 per acre to put water on the land. The power for pumping purposes is to be secured from the Idaho-Oregon Company, the plant to be installed about two miles from Webster. It is estimated that 400 horse-power will be used.

A celebration will be held at Downey, April 22nd, by the Commercial Club to commemorate the inauguration of the Portneuf-Marsh Valley irrigation project.

NEW MEXICO.

L. O. Lester and A. C. Raithel have purchased the J. C. Harris ranch of 480 acres lying three miles west of Deming for a consideration of \$12,000. The land carries with it a water-right for 320 acres under the ditch of the Mimbres Irrigation Company, commonly known as the Wamel ditch. The new owners contemplate cutting the land up into forty-acre tracts and selling it to actual farmers. It will be placed on the market within a short time.

Dr. O. A. Young, of French, and John Morrow, of

Raton, have been named as receivers of the French Land & Irrigation Company of French. The purpose of the appointment of receivers is to preserve the company to complete the undertaking and pay off the standing indebtedness and preserve the water-rights and irrigation system already operated by the company. Dam No. 2 has already been completed and work on No. 3 was almost half finished when the construction work was abandoned.

J. M. Miller has installed a pumping plant on his ranch near Lake Arthur that is pumping 6,000 gallons of water per minute. He will use the water to irrigate 800 acres of alfalfa.

Dr. P. K. Conaway of Deming is irrigating 172 acres of land from the waters of one well.

The Pecos & Toyah Lake Irrigation Company, of Pecos, Texas, has filed a copy of their charter with the state corporation commission. In their application to do business in New Mexico the company states that it wishes to construct, maintain and operate the Interstate Reservoir. The capitalization of the company is given at \$1,500,000, divided into 15,000 shares worth \$1 each, and that one-half of the capital stock is paid up. The company will maintain an office in Santa Fe under the charge of N. B. Laughlin, statutory agent.

OREGON.

Project Engineer W. W. Patch reports that most of the preliminary work in connection with the second unit of the Klamath project is now completed. This unit includes 6,500 acres situated in Poe valley and along the east side of Lost river. The land is from 12 to 20 miles distant from Klamath Falls. Engineer Patch is awaiting the authorization of the work by the Interior Department so that bids can be advertised for. The lands in Poe valley will be irrigated by extending the main canal, and the area along the east side of Lost river, comprising about 1,800 acres will be irrigated from the Griffith lateral. The water will be taken from the Lost river diversion dam. It is expected that the work will be completed during the current year, so that water can be delivered in the spring of 1913.

The State of Oregon has commenced suit against the Tomkins Land & Irrigation Company, a corporation with offices at St. Paul, Minn., to collect license fees alleged to be due the state. Under the Oregon state law, a foreign corporation is required to pay so much a year in order to conduct business in that state. The amount sought to be collected will include interest and a fine of \$100, the penalty for delinquency.

At a recent meeting of the desert land board, the contract with the Columbia Southern Irrigation Company was canceled, owing to the failure of the company to finance the project. The board, however, decided to prepare a supplementary contract and some of the member of the old company will reorganize and attempt to secure financial aid. The state is anxious that the project be completed. The company had several thousand acres of land in Crook county, and has had water on the land but never could secure enough funds to carry the plan to completion.

Recent approval by the Secretary of the Interior of the contract between the Desert Land Board and the Powder Valley Irrigation Company promises the development of 60,000 acres of some of the finest irrigable lands in the state. This project includes about 40,000 acres of land under the Carey Act and 20,000 acres of private lands, lying in the Lower Powder valley in Baker county. About 40,000 acres will be irrigated from the stored and regulated flood waters of the Powder river. The remaining 20,000 acres will be irrigated with the stored and regulated waters of West Eagle creek.

The Secretary of the Interior has authorized the Director of the Reclamation Service to execute contract with the Stockton Iron Works, of Stockton, Cal., for

furnishing a self-propelling ditch excavator for use on the Klamath irrigation project. The contract price is \$6,125 f. o. b. cars Stockton.

Maps and plans of the Warner Lake irrigation project have been filed with the state engineer. This project embraces 79,000 acres of land in Lake and Harney counties and will be financed by the Warner Lake Irrigation Company. The land has been temporarily withdrawn for about a year, and the company now seeks final segregation.

The Central Oregon Irrigation Company has filed plans and specifications with the state engineer for the north canal project near Bend.

TEXAS.

The La Pryor Irrigation Company of San Antonio has filed its charter with the Secretary of State. The company is capitalized at \$100,000. The purpose of the company is to construct and operate a canal, ditch, lake, etc., for irrigation, milling, stock raising uses and the supply by reservoirs of water to city and town water-works.

The Southern Trust Company of Houston has filed an application for a receiver for the Brownsville Irrigation Company of Brownsville, in order, they allege, that property on which there is an indebtedness of approximately \$26,000 be conserved.

Irrigation engineers from Kansas are installing a sub-irrigation plant on 17,000 acres of the Bob Brennard ranch, west of San Antonio. This ranch comprises 130,000 acres and was recently purchased by W. G. Kline of Cleveland, Ohio. Half of it is subject to irrigation by gravity. The land is to be cut up into small tracts and sold to northern colonists.

W. A. Fitch, of Corpus Christi, has obtained an option on 3,000 acres of land lying along the Nueces river and will install a large reservoir and pumping plant. More than 15,000 acres of land in the immediate vicinity will be irrigated, and the new plant will possibly be a source of supply for the water system of Corpus Christi.

The Port Arthur Rice Irrigation Company of Port Arthur will reclaim between 3,000 and 4,000 acres of marsh land lying above the city at an expense of between \$18 and \$25 per acre. The land will be drained by pumps.

J. T. Cameron, of Veron, has purchased 160 acres of land three miles east of Plainview and will install an irrigation plant on same.

Engineers are progressing favorably with the survey of the Cotulla irrigation district. The work so far done has established the fact that the capacity of the reservoir will be double that first estimated. The project requires several months of field work yet, but it is being pushed as fast as possible.

Plans are under way for the construction of a pumping plant near Mercedes, having a capacity of 210,000 gallons per minute. The plant will be located on the Rio Grande river and will be owned by the Rio Grande Land & Irrigation Company.

The Harlingen Land & Water Company of Harlingen will extend and enlarge its system to irrigate 20,000 additional acres of land at a cost of \$100,000.

Permission to operate in Texas has been granted to the Medina Valley Irrigation Company, whose principal place of business is Denver, Colo. The company is incorporated for \$1,000,000 and is a subsidiary to the Medina Irrigation Company, which is placing 60,000 acres of Texas land under irrigation.

The Wiggins Sub-irrigated Land Company has filed articles of incorporation; capital stock, \$50,000. The principal place of business is Fort Worth.

UTAH.

E. Everett, of Los Angeles, Cal., has purchased a large tract of land near Elberta, Utah. His purchase comprises 1,300 acres of land lying on the shores of Utah Lake. The consideration of the deal is stated to be about \$500,000. Water for irrigation will be taken from Goshen reservoir.

Articles of incorporation have been filed by the Taylorsville Irrigation company. Principal place of business is given as Taylorsville, and the capital stock of the company is given as \$2,500.

The Millville Irrigation Company of Logan has filed an amendment to its articles of incorporation increasing the capital stock of the company from \$10,000 to \$12,800.

The Kennedy Ditch Irrigation Company of Salt Lake City has elected the following directors for the ensuing year: Arthur Pratt, Geo. H. Islaub, La Grande Young, John R. Smith and C. A. Ahlquist.

The Green River Irrigation Land & Power Company, has filed formal application with the state land board for the segregation of 168,000 acres of land in Emery county. The estimated cost of the project is \$6,000,000. The company is a bonded concern and the legality of its bonds was tested favorably in the supreme court. Application for consideration of the plans was first made a month ago. At that time a deposit of \$14,750 was made to guarantee good faith. The land lies just out of the town of Green River, and when placed under irrigation will be one of the richest agricultural sections of the state.

The Junction Middle Ditch Irrigation Company of Junction, Piute county, has filed articles of incorporation with the Secretary of State. The capitalization is \$9,830, divided into 9,830 shares of the par value of \$1 each.

Articles of incorporation have been filed by the Cannonville Eastside Irrigation Company of Cannonville. The capitalization is \$4,000, divided into 4,000 shares of the par value of \$1 each.

WASHINGTON.

A. R. McNeal, of Lind, is installing an irrigation plant to water his 200-acre farm.

A 32 horse-power gasoline pump is being installed for irrigation purposes on the Ellis-Forde tracts, 11 miles down the Okanogan river from Oroville. The owners already have a large acreage in fruit trees and are arranging to set out 10,000 trees this spring.

Construction work on the Yelm irrigating ditch has been begun. Each owner of land in the district has bonded himself to construct a certain part of the ditch. The ditch is designed to reclaim between 5,000 and 6,000 acres of Yelm prairie land.

J. H. Fox of Spokane has been given the task of reviving the big irrigation project at Wahluke, which, after it had been capitalized for \$5,000,000, went into bankruptcy last month. Mr. Fox has been authorized by the federal court to undertake the task of reorganization and he already has men engaged to start on the construction work.

The proposed Quincy irrigation project now seems a certainty. The irrigation canal, which is destined to reclaim 1,000,000 acres in Grant county, east of the Columbia river, will have its head at Lake Wenatchee, about 12 miles from Leavenworth. The lake will be used for storage purposes, the water being raised 150 feet. It is estimated that it will cost \$20,000,000 to complete this project.

President Taft has authorized the Secretary of the Interior to make an additional allotment of \$20,000 to the Okanogan irrigation project. This money will be expended in lining with concrete, about 10,000 linear feet of canals in order to prevent excessive losses of water.

Supreme Court Decisions

Irrigation Cases

WATERS APPROPRIABLE.

Under Act Cong. March, 3, 1877, c. 107, 19 Stat. 377 (U. S. Comp St. 1901, p. 1548), making the waters of lakes, rivers and "other sources of water supply" upon public land subject to appropriation, waters running through a gulch, and derived from melting snows and spring water, are subject to appropriation. *Borman v. Blackmon*. Supreme Court of Oregon. 118 Pacific 848.

LICENSE TO MAINTAIN FLUME.

Where a person owning land consented to the building of a flume across his land and it was built substantially as agreed, the person building the flume was not a trespasser, but obtained a parole license which was not revocable, so far as executed; and the owner was without right to destroy the flume and remove it from his land. *Jones v. Bondurant*. Court of Appeals of Colorado. 120 Pacific 1047.

APPROPRIATION OF WATER RIGHTS.

In granting the right to appropriate water of a running stream for power purposes it is within the discretion of the state, through its proper officers, to limit the rights granted so as to prevent the transmission or use of the power beyond the confines of the state. Such limitation does not violate the federal Constitution as interfering with interstate commerce. *Kirk v. State Board of Irrigation*. Supreme Court of Nebraska. 134 Northwestern 167.

DOMESTIC USES OF WATER.

An upper riparian owner may take for domestic use, including water for his household and also for such animals as are essential to the proper sustenance of his family, so much of the water of a natural stream as may be necessary for that purpose, although none may be left for the lower riparian owners; such use being grounded on actual necessity. *Caviness v. La Grande Irr. Co.* Supreme Court of Oregon. 119 Pacific 731.

ROTATION OF USE.

Since an appropriator of water for irrigation is only entitled to use so much as his needs require, and at the time of such requirement, if these are satisfied by use of the whole flow every other day or every other week, the court, in cases involving prior and subsequent water appropriations, may require the appropriators to alternate in the use of the water. *McCoy v. Huntley*. Supreme Court of Oregon. 119 Pacific 481.

LIABILITY OF CANAL COMPANY.

An irrigation canal company, sued for failure to furnish sufficient water for plaintiff's rice crop during a certain season, cannot rely upon a release of liability contained in a contract for service for the succeeding season, if there was no other consideration than the agreement for such subsequent service; the company being legally bound to furnish it. *Lone Star Canal Co. v. Cannon*. Court of Civil Appeals of Texas. 141 Southwestern 799.

RIGHTS MEASURED BY ACTUAL DIVERSION.

One who makes an appropriation of the waters of a stream acquires no title to the waters, but only a right to their beneficial use to the extent they are employed for that purpose, and his right is not measured by the extent of the appropriation as stated in the notice of appropriation, or by his actual diversion from the stream, but by the extent to which he applies the waters for beneficial purposes, and beyond that the waters are subject to a subsequent appropriation by another for similar beneficial purposes. *Hufford v. Dye*. Supreme Court of California. 121 Pacific 400.

IRRIGATION GRANTS.

The Mexican government granted, on February 5, 1824, a large number of grants of water to various grantees. On a subsequent day, it granted grants of water for other land, using the same language. Few grants were subsequently made. Each grant granted to the grantees "1 day of water with its corresponding labor of land." The original grantees of both lands used the water for irrigating their lands concurrently. *Held*, that the grants did not give any superior right to any of the grantees, but the grants distributed to each

water rights in common. *San Juan Ditch Co. v. Cassin*. Court of Civil Appeals of Texas. 141 Southwestern 815.

RIPARIAN RIGHTS.

Where the court, in a suit by a lower riparian proprietor against an upper proprietor to determine their rights to the waters of a stream, found that plaintiff, as riparian owner, needed and used the water for domestic purposes, and that in the dry season there was never any surplus in the stream above such needs, a judgment awarding to defendant, as riparian proprietor, all of the water of the stream which he might require for domestic purposes appurtenant to his lands, including water for household and domestic use, watering stock, and irrigating lawns and gardens adjacent to the dwelling house on the land, was sufficiently favorable to defendant. *Filippini v. Hewlett*. Supreme Court of California. 121 Pacific 376.

DIVERSION.

Civ. Code, § 1416, prior to its amendment in 1907, provided that a claimant of water must begin diversion works within 60 days after the posting of notice and diligently pursue the same to completion. Section 1419 declared that failure to comply with such requirement forfeited the claimant's rights as against a subsequent complying claimant, but section 1422 provided that if the proposed place of diversion, or any part of the diverting canal, was within the United States forest reserve, or other public land, the claimant might commence his works within 60 days after a license from the proper officers to use the reserved lands, provided he began steps to secure such license within 60 days after posting the notice of appropriation. *Held*, that where plaintiff's notice of appropriation alleged that the places of its intended diversion and part of the route of its conduit were within the Sierra forest reserve of the United States, plaintiff having diligently prosecuted its application for use of the public land, the right of diversion was not subject to adverse appropriation until 60 days after the application to use the public land had been acted on. *Inyo Consol. Water Co. v. Jess*. Supreme Court of California. 119 Pacific 934.

REASONABLENESS OF RATES.

Complainant, an irrigation company, brought suit to enjoin the enforcement, on the ground that they were confiscatory and in violation of complainant's constitutional rights, of water rates fixed for its service by the boards of supervisors of the counties through which its canals extended under Act. Cal. March 12, 1885 (St. 1885, p. 95), which authorized such boards to estimate the value of all property actually used and useful to the appropriation and furnishing of such water and the reasonable annual expense of the service, and to fix such rates that the net annual profits of the company should be not less than 6 nor more than 18 per cent upon the value of the property actually used and useful. *Held*, that the estimate of the master of the value of the physical property of complainant actually used was made upon a proper basis and was supported by the evidence; that his finding as to the annual expense of the service was also supported by the evidence, and should be confirmed, but that complainant was entitled to have added thereto, to be deducted from its *San Joaquin & Kings River C. & I. Co. v. Stanislaus County*. U. S. Circuit Court, Northern District of California. 191 Federal 875.

ADVERSE USER.

That defendant during his occupancy of lands and for more than 10 years before the commencement of the suit has under claim of right and in good faith diverted and used for irrigation and domestic purposes all the waters flowing in a stream at the point of intake as used by him during the irrigation period when water has been low in the stream, and that such diversion has at all times been continuous, open, and notorious and adverse to plaintiffs, shows acquisition by defendant of rights of adverse user. *Farwell v. Brisson*. Supreme Court of Washington. 119 Pacific 814.

PERMIT BY STATE ENGINEER—

Where one enters land, under the desert land laws of Congress, on which is situated a spring and an artesian well, which well was constructed, prior to the entry of such land, for the purpose of increasing the flow of the water, and the water was used for watering stock, and the one who made the well thereafter sold his interest in said well to the entryman, and she made application of the water to the desert land so entered by her for growing crops thereon, *held*, that her appropriation is as valid as though she had made application to the state engineer for a permit to appropriate the same.—*Youngs v. Regan*, Supreme Court of Idaho, 118 Pacific 499.

POTATOES, SOIL PREPARATION, SEED PLANTING AND SEED SELECTION.*

By John McPherson.

Without doubt sandy soil raises the best and cleanest potatoes.

In selecting a slope select one that is not too steep, and a slope where water will not stand after you have made your irrigation. Get a good general slope.

Plow land deep in the fall and let it lay during the winter without ever touching it. In the spring disc it in the opposite direction from which plow was run.

Get seed with shallow eyes.

Do not pick the largest potato for seed, but take the average size—a typical type of the variety you want to grow.

The tendency is to breed a great many eyes at the expense of quality and size of potato.

You want to pick a seed type and of such size that you will have enough substance in the piece you plant to start and make a good heavy growth and give it a good root system.

Cut away part of end of potato and then cut it vertically.

The larger the piece of seed the more even the stand.

Get potato seed right into the ground after cutting.

Allowing seed to stand causes searing.

Always try and get the seed down to moisture so that it will start right off and grow.

Cut stem end off from potato when cutting for seed.

Plant seed from May 1st to June 10th.

There is nothing that beats a "Netted Gem."

Plant seed 10 or 12 inches apart in the rows and one foot apart between the rows and plant one seed in a place.

Always have moist soil when putting seed into the ground. Whenever you plant seed you want it to grow at once and it will not grow without moisture.

With a round potato you will not as a rule find knobs. Round potatoes are easier to grow and easier to handle.

*From Bulletin No. 1, Movable Schools of Agriculture, University of Idaho.

INTERNATIONAL INSTITUTE OF AGRICULTURE.

The Bulletin of Agricultural Statistics for February, published by the International Institute of Agriculture (Villa Umberto I, Rome), contains preliminary returns of the wheat and oats harvests in the Southern Hemisphere. The outturn of wheat is estimated in Argentina at 46,420,000 quintals; Chili 10,500,000 quintals; Australia 20,508,000; New Zealand 1,765,662; or, expressed in percentages of last year's production in the individual countries, these figures work out at 125.1; 106.9; 79.2; 78.4 respectively. If to these figures be added the wheat production of the Northern Hemisphere in 1911 as published in last month's *Bulletin*, for the following countries: Germany, Austria, Belgium, Bulgaria, Denmark, Spain, France, Great Britain and Ireland, Hungary, Italy, Luxemburg, Norway, Netherlands, Roumania, Russian Empire, Sweden, Switzerland, Canada, United States, India, Japan, Algeria, Egypt, Tunis, a total wheat production of 937,671,220 quintals is obtained, which is 99.5% of the production in 1910. The production of maize in Argentina is estimated at 70,000,000 quintals as against 7,000,000 quintals last year, when an abnormally low yield was obtained owing to the drought.

The area sown to wheat during the autumn of 1911 in Belgium, France, Great Britain, Hungary, Roumania and Japan is greater than that sown during the corresponding period of 1910, but is less than that sown in the autumn of 1910 in Spain, Canada, United States and India. The condition of the winter cereal crops in the Northern Hemisphere is good.

The *Bulletin* also contains figures of the last live stock census in the United States, which was taken on April 15, 1910.

Several communications from various governments are given among which those from Portugal, Brazil and Chili referring to the establishment of bureaus of agricultural statistics in these countries are of special interest.

YOU WILL NEED THIS BOOK.

The "Primer of Hydraulics" is the only book teaching Hydraulics in a practical way. Price \$2.50, cloth bound. THE IRRIGATION AGE, Chicago.

Reclamation of Land Made Easy With Buckeye Traction Ditcher

WHenever and wherever used in the reclamation of land or in irrigation projects or extensive road building, the BUCKEYE OPEN TRACTION DITCHER has brought about a big saving in the cost of excavation work.

¶ The saving results in the reduction of labor bills, because the "BUCKEYE" will do the work of from 50 to 150 men with spades and shovels, and from 50 to 75 per cent cheaper.

¶ The "BUCKEYE" is built in many different sizes, cutting from 2½ to 12 foot top, with any slope desired.

¶ While being operated on very soft ground, the "BUCKEYE" has made an excavation with a 4½ foot top and 2½ foot bottom, and a depth of 3½ feet, at the rate of 6 lineal feet per minute.

¶ The apron tractions make it possible to use the ditcher on land that will not sustain the weight of a team of horses and an empty wagon.

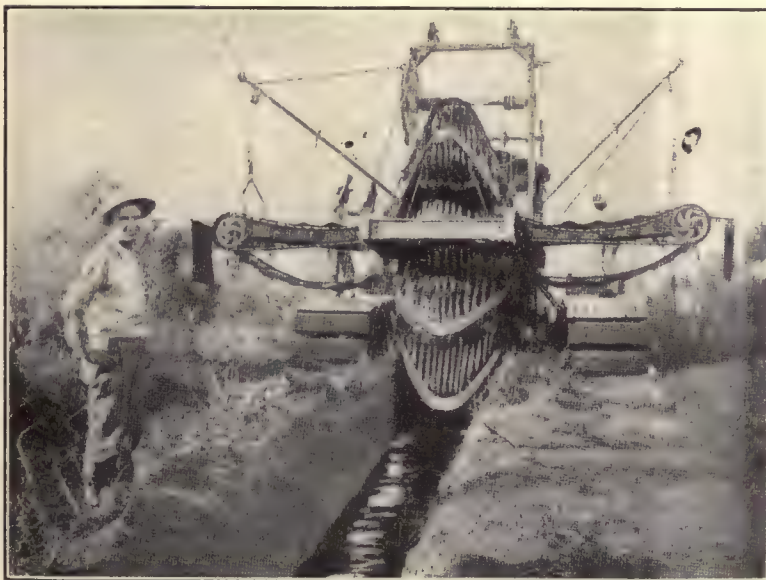
¶ For the reclamation of waste land, irrigation work and road building, the "BUCKEYE" is without an equal.

¶ Thousands of acres of waste land in the Florida Everglades, swamps of Louisiana and in other states, have been and are being reclaimed with BUCKEYE DITCHERS. Because of its fertility, this land has been rendered more valuable than the natural land adjoining.

Write Today for Catalogue No. 26

¶ We will be glad to explain the operation of the ditcher to you and show you how you can reduce your excavation cost from 50 to 75 per cent and convert thousands of acres of waste land into dollars.

The Buckeye Traction Ditcher Co.
FINDLAY, OHIO



(Continued from page 217.)

I would not advise a tight plank roof.

The floor should be made smooth so that potatoes will not be injured in shoveling them onto the sorter.

The bruising of potatoes is a serious thing. Bruised potatoes will sometimes develop dry rot.

Use a "Thompson" sorter for sorting potatoes.

We find that a whole potato planted has a tendency to set on a greater setting.

You cannot get a big bunch of potatoes without a clover and alfalfa rotation.

I do not believe you can continuously grow potatoes with continuous manuring.

We believe in a top dressing for potatoes in Colorado. We top dress one year before planting potatoes.

My experience is that poor drainage causes scabby potatoes after irrigation.

You won't get scabby potatoes planted from scabby seed planted in ground the previous year planted to alfalfa or clover.

You can plant your own seed from year to year. I think you can grow the best of seed here.

A good place to get seed is from that part of the field producing the best growth of potatoes.

I never saw a volunteer potato rot. It will not rot.

Do not cut seed pieces too small. It is a dangerous thing. Cut potatoes right to the center.

If potato is of reasonable size, the great strength comes from the terminal bud.

It is not a good thing to recommend the planting of small potatoes. They will eventually run out.

CORN PRODUCTION IN ARGENTINA.

A cablegram, dated March 25, 1912, from the International Institute of Agriculture, Rome, Italy, has been received by the United States Department of Agriculture, giving the following information:

"The estimated production of corn in Argentina this season (1911-12), is 147,927,000 hundred-weight (295,854,000 bushels)."

"INGECO" INTERNAL COMBUSTION ENGINES

Operate your irrigation pump with an "INGECO" Engine and be assured of the maximum amount of water with the minimum expense.

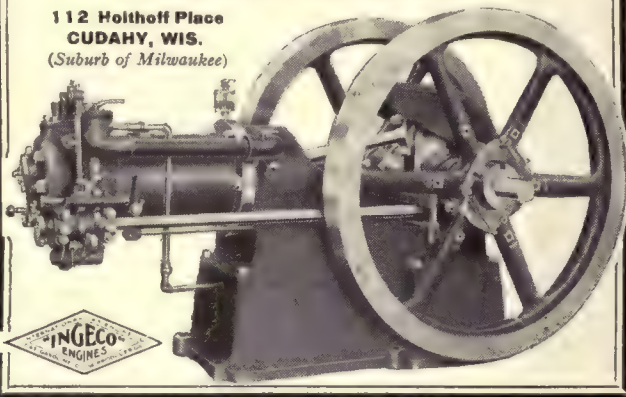
"INGECO" Engines embody every essential feature of high grade engine design and construction; mechanically operated vertical valves located in removable cages and stems are without threads or nuts to work off, have no soft gaskets under explosive pressure; governor acts direct on fuel valve and is of the inertia centrifugal type located in fly wheel, chain oiling main bearings and automatic oiling of crank permitting continuous service; magneto built on to every "INGECO" Standard Horizontal Engine.

"INGECO" Engines are easily and quickly installed, carefully balanced, no expensive foundations required, every part manufactured from jigs and interchangeable, constant attention unnecessary.

Branch sales offices in all principal cities, carrying complete stocks of engines and spare parts and are in position to give engineering advice and furnish complete pumping plants.

International Gas Engine Co.

112 Holthoff Place
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(Suburb of Milwaukee)



READY NOW: THE PRIMER OF HYDRAULICS.

By Frederick A. Smith, C. E., Hydraulic Engineer.

This new book is a splendid volume of over 200 pages of absolutely new matter pertaining to the subject of Hydraulics and its allied branches. All the subjects treated of are handled in a simple and practical way to make them of use to the men who have been unable to obtain a college education, but who are successful practical men in fields where they require a knowledge of the principles of Hydraulics and instructions how to solve their problems in a simple and satisfactory way. This book is indispensable for anyone engaged in works relating to Hydraulics, Irrigation or Drainage; it is primarily designed for the practical man in the field, but will be equally welcome to the trained Hydraulic Municipal and Railroad Engineer especially, on account of the many valuable tables compiled by the author, which will save a tremendous amount of time in computations.

Condensed Table of Contents.

Article I.	General Properties of Matter.
Article II.	Algebraic Principles.
Article III.	Geometrical Principles.
Article IV.	Trigonometry.
Article V.	Mensuration of Plane Figures.
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Article XX.	Ditch Tables and Their Applications.
Article XXI.	Flow Measurements.
Article XXII.	The Use of Logarithms.

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When you purchase land or seek a new home you owe it to yourself to obtain the best information. A member of this firm has resided in Monte Vista for 20 yrs., he knows it from A to Z and we will not list any land for sale unless **WE KNOW** it is good farming land. We have the best in all size tracts, with perfect water rights at prices which will surprise you. Write us for information regarding The San Luis Valley.

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Monte Vista, Colorado

Tables.

Fourteen tables giving the factor *C* for all cases of channels for a coefficient of roughness; *n* varying from .008 to .050, inclusive, for channels having a hydraulic radius from .01 ft. to 900.0 and for slopes varying from 0.1 to .000025, thus practically covering every possible condition.

Tables of square roots of numbers used for *r* and *s*.

Table of Hydraulic Elements of the Circle.

Table of Hydraulic Elements of Composite Section.

Table of Areas and Circumferences of Circles.

Table of Hydraulic Equivalents.

Table of Weights of a Cubic Foot of Various Substances.

Conversion Table of United States and Metric Measures and Weights.

Table of Squares, Cubes, Square Roots and Cube Roots.

Table of Logarithms.

Table of Natural Sines and Cosines.

Table of Natural Tangents and Cotangents.

Conversion Table, millions of gallons in 24 hours in other units.

Table of sizes of pipes or cylindrical conduits required for the flow of given quantities of water at given velocities.

Most all of these tables have been originated and computed by the author and have been checked in practical work and found to be correct, so that the tables alone will be worth many times the cost of the book.

The price of the book has been placed as low as is consistent with the superior quality of the work and it may be obtained on the following terms: \$2.50 a single copy, cloth bound; if order is sent with a new subscription to IRRIGATION AGE or a renewal subscription, the book will be sent and THE IRRIGATION AGE one year for the sum of \$3.00.

Postage is included in the above prices.

Send in your orders early, so as to receive early attention.

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Genuine Navajo Blankets

We are agents for the Chimayo Reservation Navajo Blankets and they come to us direct from the Indian weaver.

The kind that costs you \$50 in Chicago we will sell you for \$10. We have some excellent Navajo Blankets as low as \$6.

We guarantee satisfaction and will ship goods subject to inspection and approval.

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give all the water needed for irrigation without pumping expense or bothering with an engine.

Cost little to install—nothing to operate. Raise water 30 ft. for every foot of fall. Land lying above ditches watered at little or no expense. Pump automatically day and night, winter and summer. Fully guaranteed.



If there is a stream, pond or spring within a mile, write for plans, book and trial offer, FREE

RIFE ENGINE CO.
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Buy Direct from Owner

Save Commissions

I have been a resident of the San Luis Valley for more than 25 years; I have been actively engaged in farming and stock raising and knowing the value of lands I bought the best that could be found in the valley and took advantage of being in the valley to buy cheap. I bought my land cheap, and therefore can sell cheap.

I have about 6 quarter sections which I will sell at prices ranging from \$30 to \$40 an acre. All these lands are irrigated and have perfect water rights.

One quarter section, 2 miles from Alamosa, with perfect water right, 70 acres in native hay, ditched, watered, artesian well, \$30 an acre, and this includes 80 shares San Luis Water.

If you want bargains in San Luis Valley, call or write to

HARDIN HINES

Alamosa, Colorado

TRINCHERA COLONY TRACT LANDS

4 years ago the Townsite of Blanca was a prairie, today Blanca is a town of over 600 inhabitants and the 3rd largest town in the San Luis Valley.

The value of lands and townsite lots will increase many times in a short while. This is your chance, excellent farming land, water rights, close to town, from \$30 an acre up, HALF CASH.

If interested and if you want reliable information—We investigate for you.

Write us.

The Milford Realty Co.

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Investigations, Reports, Plans, Estimates and Construction

Financial assistance procured for projects examined and approved by this company

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AMERICAN RECLAMATION FEDERATION

(Incorporated—Not for Profit)

WITH WHICH IS MERGED

**The Chicago Irrigation Association
AND**

The American Irrigation Federation

This Federation is organized for the promotion and encouragement of the irrigation, reclamation, colonization and development of land within the United States of America. It maintains an office at 1110 First National Bank Building, 38 South Dearborn Street, where there is open to the public, free of charge, maps and publications relating to the lands of the United States. Questions relating to irrigation matters will be answered by the officers of the Federation and information given.

THE OFFICERS OF THE FEDERATION ARE:

EDMUND T. PERKINS, President
HENRY C. WOOD, Vice-President
D. H. ANDERSON, Secretary
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Organizations and individuals interested in reclamation are invited to become members. Detailed information concerning initiation fees and dues will be furnished upon application to the secretary. Address

D. H. Anderson, Secretary
30 North Dearborn St.,
Chicago, Ill.

LAND OPENING.

On April 22 the Fourth Unit of the Shoshone irrigation project in Wyoming will be opened to homestead entry by the Government. This unit lies to the north and west of the town of Powell, and contains some of the finest land on the project. The farms are mostly 80 acres each, and homeseekers are invited to investigate the opportunities afforded by this opening.

About five hundred families are already established on the first three units and have built roads, schools and churches. The project has railroad facilities, rural delivery, telephones, and there are thriving towns at short intervals.

The Shoshone project lies in a region of great scenic beauty with a delightful and healthful climate and a fertile soil. The Reclamation Service at Washington, D. C., has prepared a booklet fully describing this section and giving detailed information as to methods of acquiring these farms. This will be sent free upon request.

The Shoshone project is believed to be one of the best sections in the West for general farming. It is a fine dairy country. The farmers are now shipping an average of \$1,500 worth of cream to Billings. A new creamery is under way at Cody. Alfalfa is the main crop.

\$5.00

Genuine Navajo Blankets

My business is done directly with the Navajo Indians, whose reservation is near Aztec. I make trips to the reservation and purchase the best in the line of Navajo rugs and blankets direct from the Indian weaver. I have no middleman to pay. **Why pay \$20 to \$50 for a Navajo rug or blanket in a Chicago store when I can sell you the finest quality from \$5 to \$35, depending on size. If not satisfied after examination I will refund your money, and I refer to the Citizens Bank of Aztec as to my responsibility. Before buying a Navajo rug or blanket write me telling me size you want and get my prices.**

J. F. WOOD, Aztec, New Mexico

Irrigators, Attention!

WE have a district of independent water-rights. No weeds from a community ditch, no waiting your turn for water, no chance for water-thieves to steal your water. On the other hand, our farmers have water whenever they want it. It is the purest water in America. The original water-right costs but \$20 or \$30 per acre, and is based on the most dependable supply of water for irrigation on the globe—namely, on the great underflow of the Mimbres Valley, which has a watershed of 1,400 square miles and a pumping area of only 125,000 acres at the most. The lift for water varies from 15 to 100 feet, and with improved devices for raising water, every well-informed man knows that where abundant water can be secured at such a lift, the pumping plant makes the surest, cheapest and most dependable water-right in the world. We have it here. Also low values. It is just the sunniest and most beautiful valley in New Mexico, and just the place to build a cozy country home that will make you and your family independent for all time to come. Now is the time to get in on the ground floor. Less than five per cent of the irrigable area is reclaimed. This, of course, means rock-bottom prices. Write Secretary, Deming Chamber of Commerce, Deming, N. M., for a booklet describing the best irrigation proposition in America. Don't wait. Write now.

Please mention name of this publication.

producing from 3 to 6 tons per annum. The new alfalfa meal mill at Powell will pay the farmers under contract \$6.50 per ton loose at the mill for a period of five years. Another profitable crop is sugar beets.

FATTENING HOGS IN NEBRASKA.

The Nebraska Experiment Station has just issued Bulletin 123, which includes the result of several years' work in fattening hogs on alfalfa and corn, and on alfalfa, corn and other grains and mill products, at the North Platte Substation. The results of feeding alfalfa hay in the rack, chopped alfalfa and alfalfa-meal, and of feeding various proportions of corn and alfalfa are compared. This bulletin follows Bulletin 121, which shows the cost of keeping brood sows, the cost of the pig when it has reached the weight of 50 pounds, and the cost of growing pigs during the Summer. This bulletin may be had free of cost by residents of Nebraska on application to the Agricultural Experiment Station, Lincoln, Nebraska.

Opportunities Beckon at Del Norte

A welcome awaits you here, Mr. Homeseeker, Farmer, Investor and Land Buyer. The Del Norte section of the famous San Luis Valley, Colorado, offers you opportunities and advantages in the way of new homes, fertile irrigated land, safe investment and bountiful water supply, second to none in the Western States. A delightful climate, churches, schools, pure water, fertile soil and thousands of acres of government homestead and state lands are what we offer. Send for our booklet, "FACTS ABOUT DEL NORTE SECTION." A postal brings it.

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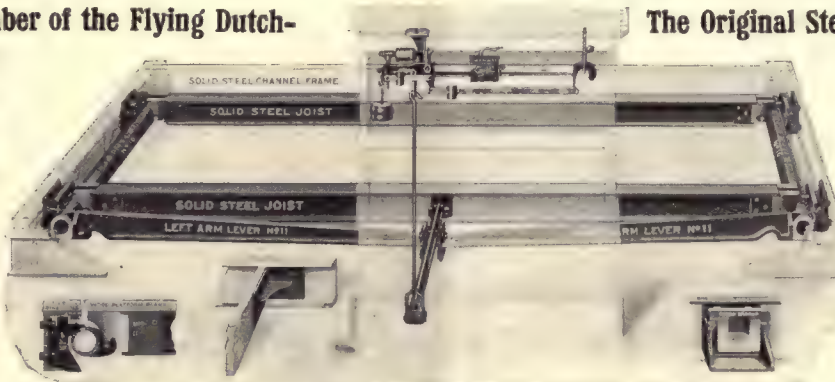
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The McDonald Pitless represents the highest quality of workmanship, material and finish, it is the most substantial in construction and will support the heaviest weights in the most accurate manner. The average shipping weight of the four and five-ton McDonald Pitless with frame 8 by 14 feet is 1,650 pounds; please compare this weight to some other scale that you have in view, you will find that we put from 300 to 500 pounds more material in the construction of the "McDonald Pitless," which insures correct weights under a heavy load; while the lighter constructed scale may weigh a light load accurately you will find in most cases the scales of lighter construction will vary, causing you a loss from which there is no possible recovery.

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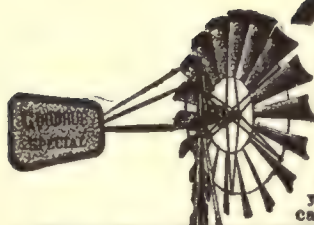
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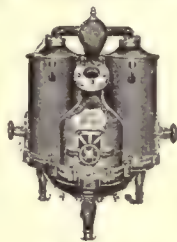
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Sand on either outside or in cannot injure them. Will raise and force water, sand and gravel any distance required.

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Weights less than half as much as the heavy graders and does better work at one-half the expense. Easily handled by one man. Drawn by two or four horses. Let us send you particulars and pictures showing what the 20th Century Ditcher has done for others and what it will do for you. **Write today. Address,**

The Baker Mfg. Company, 526 Hunter Building Chicago

The number of independent enterprises reported in 1909 was 114, against 119 in 1899, a decrease of 4.2 per cent. The length of main ditch in 1909 was 54 miles, against 68 in 1899, a decrease of 20.6 per cent. In view of the increase in the area irrigated, it is probable that these decreases are due to differences in enumeration rather than to actual decreases in the number of enterprises and length of ditches. The number of reservoirs reported is 11, with a combined capacity of 22 acre-feet. The number of wells pumped for irrigation was 65, and the acreage irrigated with pumped water is 119, or slightly less than 2 acres per well.

The total cost of irrigation systems reported for 1910 was \$45,200, against \$19,672, an increase of \$25,528, or 129.8 per cent. The average cost per acre in 1910 was \$6.10, against \$7.13 in 1899, a decrease of 14.4 per cent. The average annual cost of operation and maintenance per acre in 1909 was 51 cents.

No irrigation enterprises in the state are operating under the Federal reclamation act (act of June 17, 1902), the Carey Act (act of congress August 18, 1894), or irrigation district laws. Co-operative enterprises supplied water to 2,000 acres. The remaining 3,402 acres were supplied by individual and partnership enterprises. Streams supplied 5,269 acres, or 97.5 per cent of the total area irrigated. Of the remaining acreage, lakes supplied 28 acres, wells 69 acres, springs 16 acres and reservoirs 20 acres.

THE ARROWHEAD

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Contains useful and instructive information to anyone contemplating a home in the West.



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LOS ANGELES, CAL.

NEW DEVELOPMENT IN COLORADO.

February 27, 1912.

THE IRRIGATION AGE, 30 N. Dearborn St., Chicago, Ill.

Gentlemen:—The enclosed clipping from the Denver (Colo.) *Republican*, relating to the development of Paradox Valley in San Miguel and Montrose Counties, is substantially correct.

The construction of the irrigation works required, includes about twenty miles of heavy rock work, about 10,000 feet of tunneling, three inverted siphons (the longest being about one-half mile, maximum head 500 feet), two reservoir dams, the larger being 175 feet in height; in all about 100 miles of conduits, ditches and laterals, and at least 50 miles of narrow gauge railroad.

Yours truly,

ROBERT M. F. DOBLE,
Chief Engineer,
Placerville, Colo.

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These are the shoes that "stand the racket"—have great wearing service, perfect fit and are very comfortable.

Mayer Honorbilt Shoes are built on honor. Made of the finest grade leather—specially selected for its durability, toughness and pliancy.

The leather is treated to keep out water and moisture.

Wear Mayer Honorbilt fine shoes for dress-up occasions. Made in many styles and all heights. If you want the best in shoes insist on the genuine Mayer Honorbilt.

Sold by dealers—if you cannot find a dealer, write to us. Look for the Mayer Trade Mark on sole.

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By using the Campbell System of Scientific Farming you can produce a bumper crop on one-half the water ordinarily used. It is done by better tillage and a thorough conservation of the moisture and plant food. Many irrigationists are developing their orchards and maturing their fruit on one irrigation a year by employing the Campbell System—storing the water in the soil. This system prevents leaching, and keeps the soil fertile and sweet at all times. You are not bothered with alkalinity. Your land is never water-logged, thus depriving the plant of the necessary air to insure a quick healthy growth. Plants do not grow while the soil is water soaked.

The Campbell Correspondence School

is the result of thirty years' experiment and demonstration by Prof. Campbell and his associates. This course teaches when to plow, how deep to turn the ground, all about cultivation, and the time WHEN and HOW to do the work.

THE CAMPBELL SYSTEM is used the world over. It is practiced in Spain, Hungary, Italy, India, Australia and North and South America. Wherever intelligently used, by irrigator or dry land farmer, it has doubled the yield.

Send us your name and address on a postal and we will mail you, **FREE**, a copy of the Scientific Farmer and a catalog of the Correspondence School.

Campbell Soil Culture Co.
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Irrigated Farm and Fruit Lands

The small irrigated farm or orchard means greater production with less labor. It takes away the element of chance and makes a good crop a reasonable certainty.

The land in the Northwest such as is being irrigated by government and private projects in Montana, Idaho, Washington and Oregon, on or reached by the Northern Pacific Railway, is exceedingly rich and requires only moisture to yield bountifully. This moisture is provided by irrigation, which makes irrigated farming, fruit and vegetable raising a scientific profession, not a drudgery. The ideal climate is a strong argument in favor of the Northwest.

If you want to know more about the possibilities of making your efforts bring you greater returns, write for information about these irrigated lands. Maybe the "dry farming" territory will interest you. Write tonight and state what section you are most interested in. Don't delay. The information will cost you nothing and will pay you well.

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BACK TO THE LAND

Tens of Millions of Idle Acres of Land Waiting for Millions of Idle Men.

How distribute the millions of idlers over the millions of unused acres, giving all employment, opportunity to produce, a chance to earn support, and acquire homes, while abolishing poverty and crime?

Where are the millions of vacant acres and what are the conditions by which the tens of thousands of willing workers may come into their possession? How bring the land seeker and the land together?

These are the live, burning questions of the hour.

Considering the great importance of these questions being honestly and impartially answered, without influence from land speculation, the Hill Standard Book Company has recently brought out a publication entitled "Hill's Reference Guide for Land-Seekers, Travelers, Schools, Tourists, Emigrants, and General Readers." The writer of this new volume is Thomas E. Hill, author of the widely known "Hill's Manual of Social and Business Forms," whose ability in the preparation of reference books is universally recognized.

Added to large experience as an author of reliable standard books, Mr. Hill has had opportunities which specially fitted him for the preparation of this later book. Born and reared on a bleak, sterile Vermont farm where hard labor and continual renovation of soil was a necessity, he has traveled extensively in later years over the United States, has made a study of soils and farming conditions and for several years has acquainted himself with opportunities for land seekers, emigrants and new settlers in all parts of the United States. The results of his study and investigation are seen in this new publication, "Hill's Reference Guide for Land Seekers."

While the title of this new publication is partially expressive of its purpose, it fails to give an adequate idea of its great worth.

To enumerate more fully:

It is an Atlas, giving a map of every state and county in the United States, and much more clearly defining their boundaries than any other work on geography.

It is a Cyclopaedia, giving history, area, growth in population, climate, extremes of heat and cold, crops which can be grown, elevations above sea level, prices of lands, manufacturing conditions, transportation facilities, possibilities and future probabilities in every state.

It is a Geography, giving map of the world, explaining how continents, seas and oceans are made, shows the great divisions of the earth, the relative space occupied by the United States on the North American continent, with the 2,770 counties and the 23,664 cities and villages belonging to this government.

It Contains a Census Report, giving the latest population of the states, the number of persons in each state to the square mile, growth in the past 20 years, and 1910 populations of each city and village in the United States, containing 200 people and more.

Government Irrigated Lands—It contains map and description of each of the government irrigation projects in the United States, number of acres irrigated by each, amount of water supplied by each, where government irrigated land may be bought and in how small or large quantities, conditions of purchase, location of government land offices, where application for irrigated land may be made, etc.

Prices of Farm Lands in Eastern States—Extracts from advertisements detailing size of fields, wood lots, maple sugar and apple orchards, number of fruit trees on the premises, brooks running across the farm, condition of the buildings, nearness to village, post-office, railroad stations, etc.

Renovation of Worn-Out Land—A chapter on fertilization of land encourages the land seeker who has bought a run-down farm, by telling him how to so restore the land to its fertile condition as to give him the great crops his land bore in former years.

Statistical Tables—These give important condensed facts relating to each state, showing when each was admitted to the Union, capital of each, terms of office of governors and their salaries, electoral vote of each state, when legislature meets in each state, length of session, etc., etc.

New Method of Finding Locations—It is an admitted fact that most people are ignorant of geography. They have no idea of where towns of which they read are located, nor their size. This new reference guide remedies that difficulty. By a new method originated by the author, it is possible to take up this Guide from the table, open to state, county and any town of 200 people or more, and know its population and location in 10 seconds.

This new system of quick finding makes reading doubly valuable. To "look up" the place about which we read is to learn geography. Thus, almost insensibly, we absorb knowledge of cities, localities and general information which we do not possess with a long, labored process of finding.

For Shippers—Business men having anything to send anywhere, tourists, travelers, railroad officials, newspaper writers and others, who should know and must know about where located and size of the town immediately, reap the profit from saving time in this method of quick finding.

Distance Tables—Added to the foregoing are distance tables which give immediate information as to the distance to important towns from several of the great central cities in the United States. This is another great saver of time which every reader values highly.

Much Else could be said of the new and important advantages of this Reference Guide, but space forbids.

We Advise the Reader to buy it as one of the most efficient aids in existence in getting people out of the congested cities and on to land.

The publishers of this paper stake their reputation in saying that the person who buys this book will affirm that it is one of the best books he has ever seen, a beautiful book, in artistic binding, a saver of labor and a great educator.

Our faith in this work is shown in the fact that we have arranged to sell it, supplying it at the following prices:

Elegantly and substantially bound in rich maroon-colored silk cloth, cover stamped in black and gold, marbled edges, fine highly calendared paper, designed to keep the volume light enough to be easily handled. A beautiful parlor table ornament, delivered, transportation charges prepaid, by express or mail as ordered.

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Progress and Plenty

FARMERS, tradesmen, manufacturers, laborers—all are producers for the common good. Without the farmers the rest of us would starve. Without tradesmen to distribute it, grain would spoil in barn and bin. Without the machines made by manufacturers and laborers, the great modern crops of grain and hay would never be planted, or, if planted, would rot in the fields for the lack of adequate means of harvesting. On the other hand, by working together, we produce the bulk of the world's grain.

The day of farming without machines is gone forever. The manure spreader, gang plow, disk, and harrow prepare the way for harvesting and haying machines. A thousand acres are cultivated today with greater ease and dispatch than a hundred were forty years ago. Credit for this greater efficiency and for the fact that thousand-acre tracts are planted to grain and harvested safely, belongs to the farmers who use harvesting and haying machines and tools made and sold under the following names:

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As the cradle succeeded the reaping hook, the reaper the cradle, and the self binder the reaper, more and more men were freed from the drudgery of the harvest field to take their rightful places in other gainful occupations. Now that binders are in universal use, one-third of the people of the United States raise wheat sufficient to feed the whole country and have millions of bushels left for export.

Progress and plenty for all depends upon the right choice of harvesting machines by the farmers of this country. Your share of the harvest profit means much to you, but it means more to others. To be sure that your crops are harvested without waste and at the right time, buy machines suited to the conditions in your fields, tested by actual work in similar fields, machines which have behind them a history of more than fifty years of success, and which have been developed to practical perfection—I H C machines.

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No matter what the condition of your grain at harvest time—standing, down, or tangled, short or tall, an I H C machine will cut it with the least loss or waste, and bind it into bundles of uniform size convenient for handling. The machines are so simple that they may be trusted safely to unskilled help. The quality of the steel and iron in them is proved. They will stand up under the roughest regular usage of the harvest field.

When the harvesting is once begun you cannot afford delays. Should accident happen to an I H C binder and a repair be needed, you are no farther from the necessary part than your dealer's place of business. When you get that part, it will fit without filing, scraping or pounding—so accurate and so true to gauge is each part made. This feature does away entirely with expensive, aggravating delays, and makes your harvest sure—completely finished in good season. That alone is good enough reason for buying an I H C machine.

Osborne Plano

A good machine should have good twine to bind with. Our brands—Champion, McCormick, Osborne, Deering, Milwaukee, Plano, and International—made in four grades—Sisal, Standard, Manila, and Pure Manila—are made to work smoothly and without waste or trouble on I H C machines.

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The purpose of this Bureau is to furnish, free of charge to all, the best information obtainable on better farming. If you have any worthy questions concerning soils, crops, land drainage, irrigation, fertilizer, etc., make your inquiries specific and send them to I H C Service Bureau, Harvester Building, Chicago, U S A



ENGINE GANG PLOWS IN DEMAND.

The application of power to farm work and its effect on farm labor and crop production is one of the most striking exhibitions of modern efficiency applied to a fundamental work.

Farmers the country over are intensely alive to the situation and the vast business possibilities under this new method of farming. The sale of engine gang plows is probably the best index to the situation. The following clipping from the *Minneapolis Daily News* is very indicative of conditions in the great Northwest:

"The Great Northern Implement Company, which is handling the J. I. Case plow, made by the J. I. Case Plow Works, reports an exceedingly active sale this spring in the four and six bottom motive-power plows. Many larger ones have been sold also. As a four bottom plow can do approximately twenty-five percent more work than four two-horse teams and outfits, small farmers are rapidly begin-

ning to see that a motive-power plow is a saving in time and expense.

"The demand for gasoline-run plows is the heaviest by far this year that I have ever seen with our firm," said W. C. Warren, assistant sales manager of the Great Northern Implement Company, today. "Scarcely a day passes that we do not sell from two to four outfits. Motive-power plows are coming to be the thing on small farms as well as the large ones. The gasoline-run plow will save much time and expense, and then it does not cost anything to keep it when it is idle."

"The uniformity of depth and width of furrows cut by the J. I. Case engine gang is its most striking feature. Each gang is held the correct distance apart by means of a bumper extending from the middle of each beam across to the next one. Aided by the bumpers and lining-up chain, the rear furrow wheel also helps materially in removing landslide friction from all the plows. The lining-up chain is placed on all J. I. Case plows more than four bottoms."

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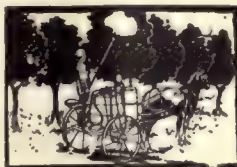
are sprayers of quality. Winners of the gold medal in the spraying machine contest held by the National Horticultural Congress at Council Bluffs, Iowa, November 10th to 19th, 1910. Sprayers for every purpose—Hand or traction power. If you grow one or one hundred acres of fruit or field crops, you need a Hurst Sprayer.

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AN INTERESTING BULLETIN.

Editor, IRRIGATION AGE:

The Nebraska Experiment Station has just issued Bulletin No. 125, on "Wheat Breeding Experiments." A brief historical sketch of wheat culture is given, together with charts showing the principal wheat growing areas. The total yield for the last decade was twice that of the preceding, and about four times that of the decade 1870-1880. The increase is largely due to increase in culture of Turkey Red wheat, which first came into the state about 1890. The improvement of Turkey Red wheat was taken up by the Nebraska Experiment Station in 1902, and has been continued since.

Single heads and plants were selected from large fields, and the product of each head increased until sufficient had been secured to plant test plots in the fields. Field tests with each strain were conducted for four years to determine the best. Quite marked variations were found in the different pure strains of wheat, both in yield of grain and in quality as well. Also, marked differences in lodging and winter-killing were noted. The yield of 26 pure strains varied from 28.8 bushels to 40.7 bushels, as a four-year average, while the original Turkey Red wheat average 35.1 bushels under the same conditions.

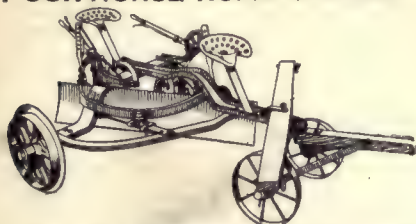
Twenty-one farmers also grew eight-acre fields of the best selected strains in comparison with ordinary Turkey Red winter wheat and secured an average of 25.9 bushels as compared with 21.9 bushels for their own wheat, or a gain of four bushels per acre.

This bulletin may be had free of cost by residents of Nebraska upon application to the Nebraska Agricultural Experiment Station, Lincoln.

E. A. BURNETT,
Director.

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For Drainage, Irrigation, Dry Docks, Excavations, Coffers Dams and all places where large volumes of water must be moved, the SANDOW engine and direct connected centrifugal pump is a perfect proposition. Pumps from 75 to 4,000 gallons per minute. Engine 2½ to 20 horsepower.

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Its Cost is Small



Guaranteed. Uses cheapest fuel—kerosene or distillate. Write stating your needs. We will quote you by return mail. Address Irrigation Dept. for Catalog No. DETROIT MOTOR CAR SUPPLY CO. Detroit, Mich.

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"Took just 3 minutes to put a very dull axe in perfect order," writes J. A. Sudan, Newark, Del. Sharpens plows, sickles, and all tools amazingly quick. 25 times faster than grindstone. Will not draw temper. The Luther Farm Tool Grinder has shaft drive, enclosed bearings. Low price. 5 yrs. guarantee. 30 attachments to select from. 30 Days Free Trial One Year Approval

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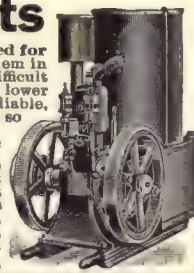
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are the best that money can buy. Sold at lower prices than are asked for inferior plants. No more irrigation troubles! We have solved the problem in a way that is at once the most satisfactory and economical. No matter how difficult your installation may be, we can fit you out with a better outfit at a lower price than you can get elsewhere. You MUST have a thoroughly reliable, strong, simple and economical engine, and there is none other so efficient as the



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In combination with just exactly the right pump adjusted and arranged in just exactly the right manner for your particular work. If you want advice as to how to proceed to get the best results with the least investment and cost of operation, write us at once, giving full and complete details, addressing your letter to our Irrigation Specialist, Detroit Engine Works, P. O. Box 601, Detroit, Mich.



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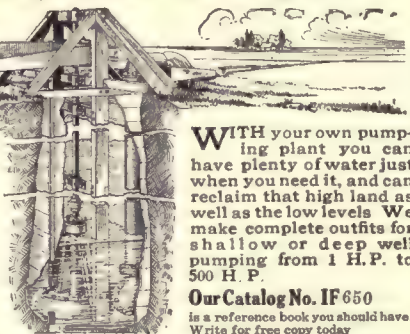
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1,000 to 400,000 gallons per hour can be handled successfully by
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THESE engines operate on kerosene gasoline or crude oil distillate. They are reliable, easy to start and care for, durable and always develop more than their rated power. It will pay you to investigate our equipment. It is designed by men experienced in practically every form of drainage or irrigation. 25 years experience is back of our engines and pumps.



WITH your own pumping plant you can have plenty of water just when you need it, and can reclaim that high land as well as the low levels. We make complete outfits for shallow or deep well pumping from 1 H.P. to 500 H.P.

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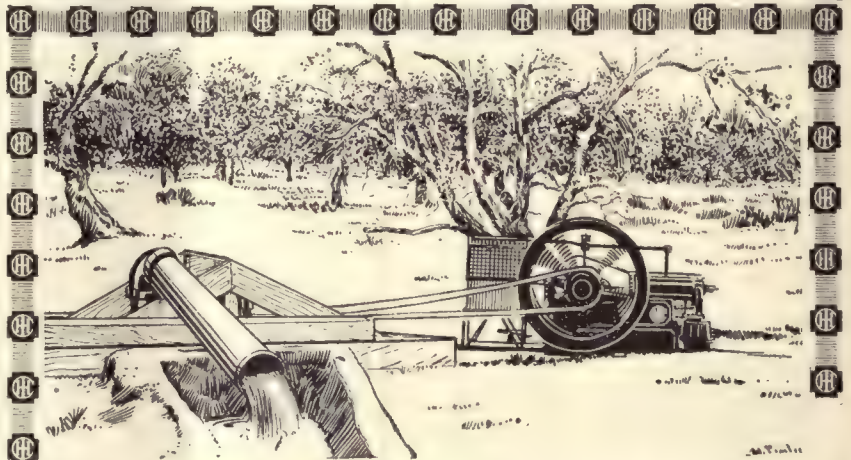
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ANOTHER STEP

The development of the Reinforced-Concrete Dam has demonstrated that there was room for good thinking along the line of Hydraulics. There is still room.

The Hollow Core Wall for earth embankments or hydraulic fills which is the subject of this advertisement, is so obvious at a glance that but little discussion is necessary.

Figure 1 shows the approximate line of saturation of the ordinary earth dam, the section being that of the famous Necaxa dam in Mexico which sloughed out during construction. The control of the "line of saturation" has been the perplexity of engineers since earth dams were built.

It is well understood that the saturated under-body of an earth dam becomes a lubricated plane on which the whole structure is liable to slip. In other words, the ordinary earth dam is upside down as regards stability. Puddle walls of clay, concrete core walls, etc., have been and still are used and serve a certain purpose. But a clay wall is not impervious to boring animals or immune against shrinkage, and a concrete core wall, if massive, is very costly, and if light, is liable to destructive distortion.

Furthermore, the material in the dam loses effective weight in proportion to its buoyancy. The degree varies with the nature of the material but some loss always exists. Thus, if the material were supposed to be open gravel weighing, when dry, say 120 pounds per cubic foot when submerged it would weigh only 84 pounds per cubic foot owing to the displacement of the water and allowing 40 per cent of voids; and similarly with other material. The down stream prism of the dam being protected by the hollow core wall is always dry and therefore always up to full efficiency and weight.

One of the salient features of the Ambursen Dam which received instant recognition at the hands of engineers and laymen alike was the facility afforded for absolute inspection of every square foot of its interior. We have now done the same thing for the earth dam and at no sensible increase of cost.

The Hollow Core Wall is built of reinforced concrete, using a system of slip forms which admit of rapid and economical construction. It consists of two comparatively thin parallel walls spaced by ribs which are monolithic with the whole structure, and capable of withstanding the external earth pressure. The up-stream wall is keyed into the impervious sub-structure whether of rock, clay, hardpan, etc., effectually intercepting the "creep" of water along the junction plane. In the illustrative section the substructure is shown as rock, although the occasions are comparatively rare when the immediate foundation of an earth dam is of this material.

The down-stream wall need not be keyed in at all, or at most but slightly. If deep lying water-bearing seams are suspected they may be reached and tapped off by a series of drill holes along the bottom of the core wall.

Drain pipes with open joints and of large capacity are led from the core wall at frequent intervals out through the embankment, discharging into gutters on the down-stream side. The joints are cemented as they approach the toe of the embankment in order that they may not be clogged by penetrating roots.

It is obvious that any water which may find its way through the sub-material or which may come through any joints in the core wall, or from any source whatever, is absolutely intercepted by the hollow wall and drained away. For the first time, therefore, we have secured an absolutely dry earth prism for the down-stream section of the dam, thus materially increasing its stability.



FIGURE 1. Line of saturation and slip, Necaxa Dam.

Moreover, the Hollow Core Wall penetrates the heart of the whole mass. It is well lit from above and is accessible by a permanent ladder-way of iron rungs extending to the bottom. Openings through the parti-walls at various levels give access to every foot of both surfaces. Any unsuspected leak may therefore be located and if possible remedied. If it is not serious enough to be troublesome, or if it is incapable of being remedied, we at least make certain that it is powerless for harm.

The Hollow Core Wall is arranged to be covered by plank tompons in the winter, so that the space is not filled with snow and ice.

Figure 3 is a photograph of the little earth dam in the famous Horseshoe Bend on the Pennsylvania road near Altoona. This dam is so located that it is subject to violent wind gusts down a gorge

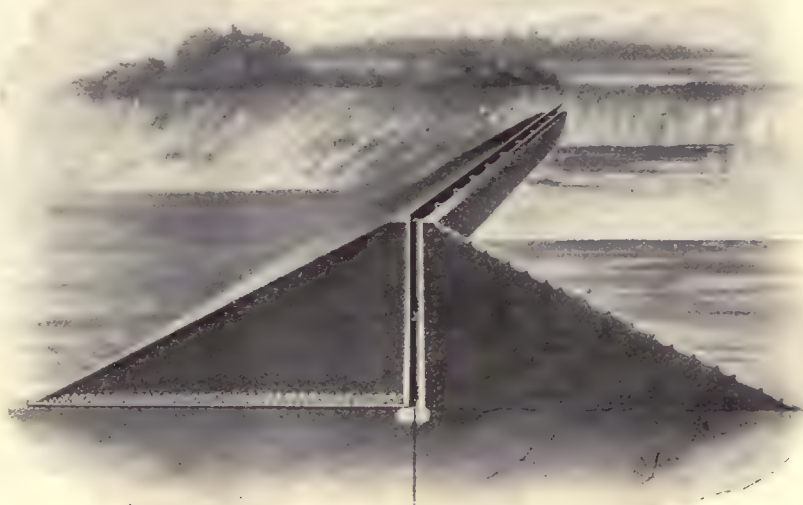


FIGURE 2. Earth Dam with Hollow Core Wall and Drains.

of the mountains. A few years ago such a gust pushed the water to the lower end of the dam and actually blew it over the edge of the dam. The result was the beginning of a severe wash, as shown in the illustration.

Now, in many locations, notably in Colorado, and the states on the eastern slope of the Rocky Mountains, the slope of the land is such that the dams are in the southeast ends of the valleys. The prevailing heavy winds are from the northwest, and hence a wave run is set up which expends its full force on the dam and is a serious menace.

To meet this we carry the down-stream wall up somewhat above the level of the embankment and thus effectually intercept any wash that may occur from this cause or from the accidental overspill of the dam due to extraordinary floods or carelessness in handling the waste gates. Such a device as this would have saved the dam that caused the Johnstown disaster and many others which have gone out under similar conditions.

It must not be hastily inferred that the Hollow Core Wall increases the cost of the dam. The chances are that it actually decreases it. This is too broad a subject to discuss in an advertisement, but it will be fully amplified in our circular on EARTH DAMS which we will send on application.

There is a modification of the Hollow Core Wall which relates particularly to Hydraulic Fill Dams and will be made the subject of our next advertisement.

Respectfully submitted,

Ambursen Hydraulic Construction Co.
Engineer — Constructors
58 Pearl St., BOSTON, MASS.

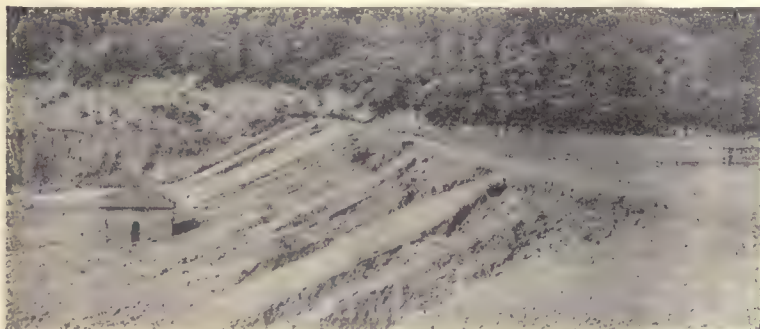
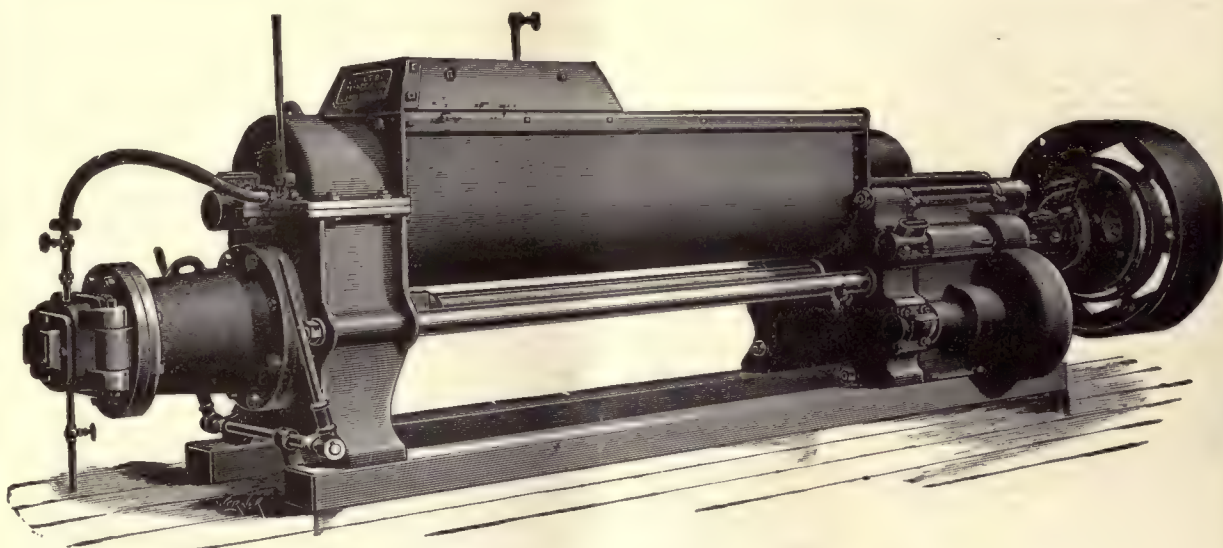


FIGURE 3. Earth Dam at Altoona, Pa., showing effect of wash.

All inquiries from Canada should be addressed to AMBURSEN HYDRAULIC CONSTRUCTION CO. OF CANADA, Ltd. 465 Dorchester St. W. Montreal

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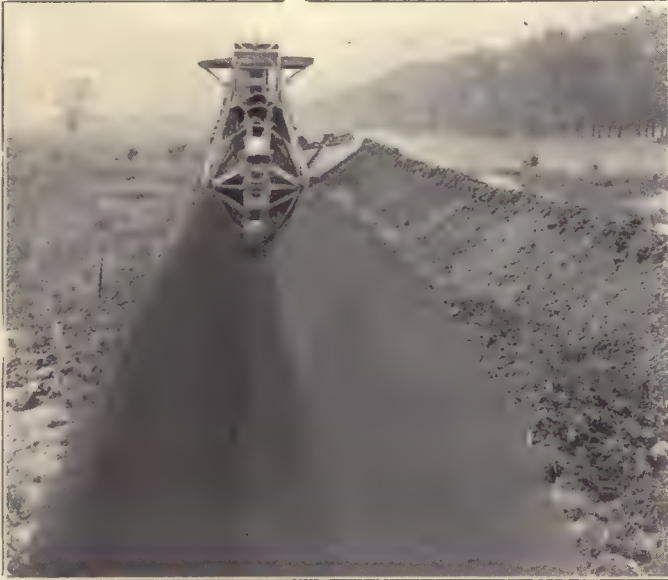
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WITH BANK-SLOPING ATTACHMENT

Will dig vertical tile trenches or sewer trenches up to $2\frac{1}{2}$ ft. wide and 10 ft. deep, and can be changed quickly to dig open ditches 5 ft. deep, 13 ft. top width, with sloping sides. One convertible-boom machine equips a contractor to dig any type of drainage ditch or trench. It will straddle an old open ditch and perfectly shape and clean it, or dig a tile trench at the bottom of the old ditch.



Wherever the Economics of Ditching Receive Consideration the ditching machine has replaced hand labor. The contractor must bid in competition with machine work. It is important, then, not merely that he shall have a machine ditcher, but that he shall have the most efficient machine ditcher. The race is no longer between the man with a ditcher and the man with a shovel, but between two men with ditchers.

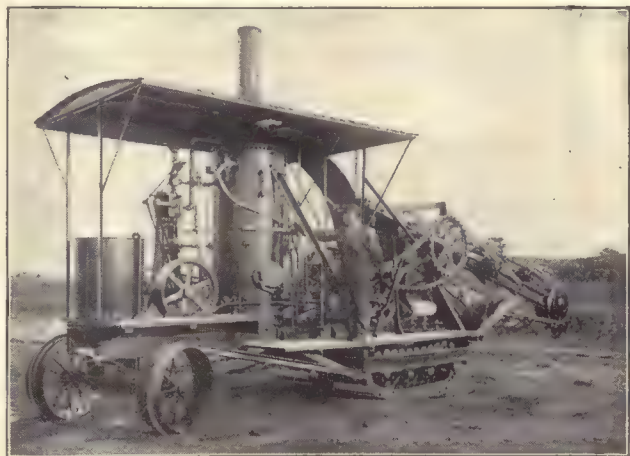
The Austin Ditch Machine with Bank-Sloping Attachment is an all-steel machine with working parts of spec-

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	Farm Tile Ditcher

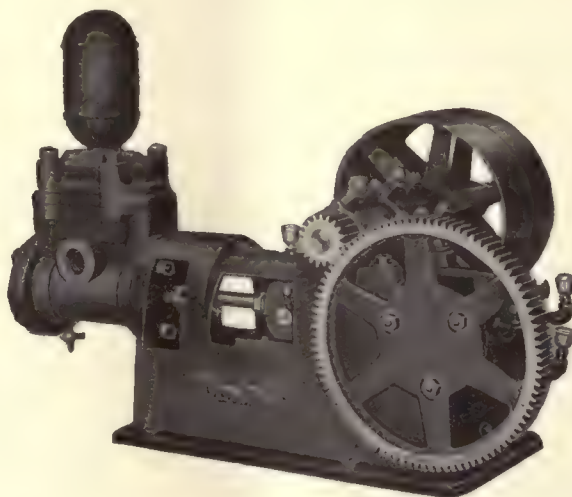
Austin Sewer and Waterworks Excavator
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F.C. Austin Drainage Excavator Co.

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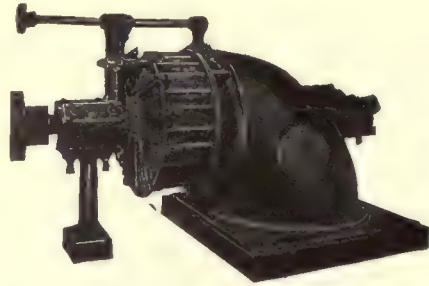


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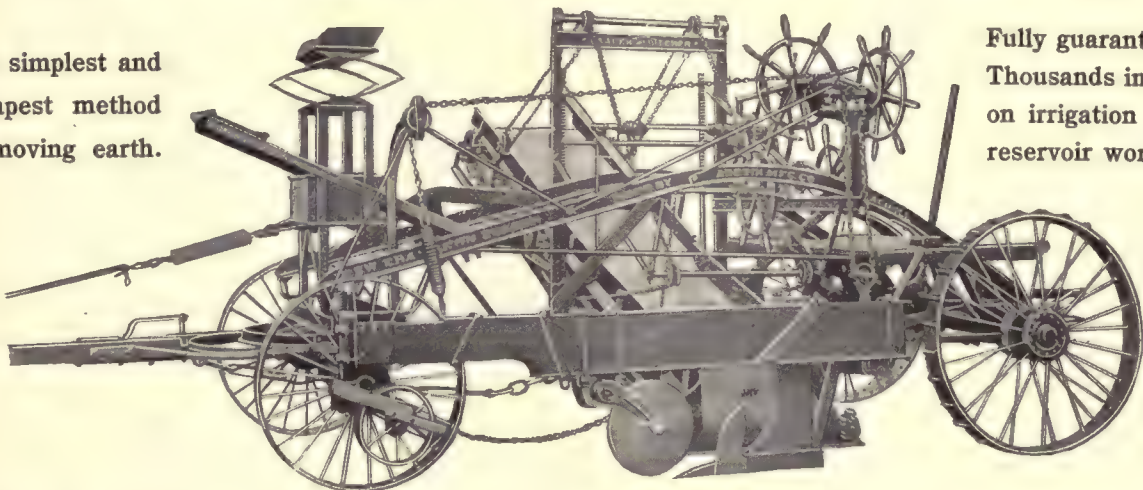
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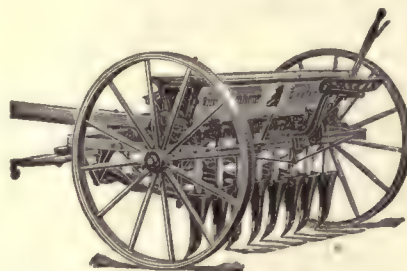
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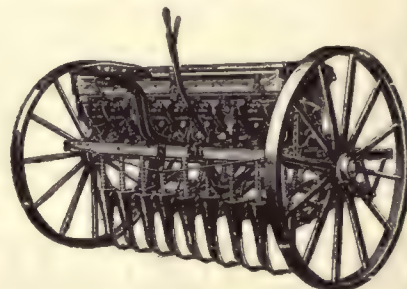
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This Cot
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Can Be Set
Up or
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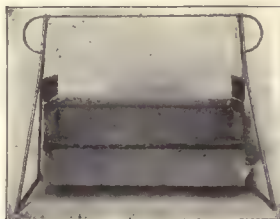


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Enterprise Couch Hammocks

The "Kumpak" Cot



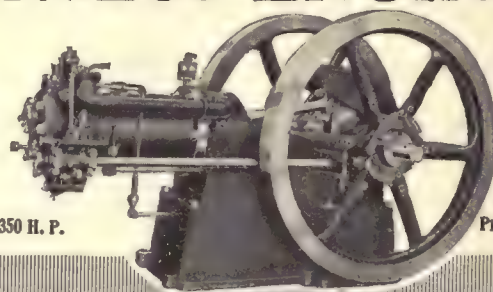
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International Gas Engine Co.
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(Suburb of Milwaukee)

Twenty-seventh Year

THE IRRIGATION AGE

VOL. XXVII

CHICAGO, MAY, 1912.

No. 7

THE IRRIGATION AGE

With which is Merged

MODERN IRRIGATION
THE IRRIGATION ERA
ARID AMERICA

THE DRAINAGE JOURNAL
MID-WEST
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D. H. ANDERSON
PUBLISHER,

30 No. Dearborn Street,
Old No. 112 Dearborn St.

CHICAGO

Entered as second-class matter October 3, 1897, at the
Postoffice at Chicago, Ill., under Act of March 3, 1879.

D. H. ANDERSON, Editor

ANNOUNCEMENT.

The "Primer of Hydraulics" is now ready; Price \$2.50.
If ordered in connection with subscription \$2.00.

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To United States Subscribers, Postage Paid, . . . \$1.00
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America. D. H. Anderson, Secretary.

Official organ of the American Irrigation Federation.
Office of the Secretary, 212 Boyce Building, Chicago.

Interesting to Advertisers.

It may interest advertisers to know that The Irrigation Age is the only publication in the world having an actual paid in advance circulation among individual irrigators and large irrigation corporations. It is read regularly by all interested in this subject and has readers in all parts of the world. The Irrigation Age is 27 years old and is the pioneer publication of its class in the world.

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Irrigation Contracts Require Care

The Supreme Court of the State of Texas has quite recently handed down an important decision of great interest to irrigators. The case under consideration was that of the Raymond Rice Canal & Milling Co. against W. F. Erb and W. E. Wright for failure to supply water according to contract. The evidence showed that the Raymond Company had a contract with Erb and White to furnish them with enough water for 350 acres of rice land to produce a certain number of sacks of rice to the acre at the rate of \$7.50 per acre. Then in consequence of a long-continued drouth the water supply failed and the Raymond Company received only its proportionate amount of the available water, for which that company brought suit for damages. The District Court which tried the case first decided in favor of the defendants, but the Appellate Court found for the complainant which the Supreme Court affirms the finding of the District Court and reverses that of the Appellate Court.

The decision rests upon the provisions of the Irrigation Act of 1895 which provides that in case of shortage of water from drouth, accident or other cause the water to be distributed shall be divided among all consumers pro rata, according to the amount they may be entitled to so that all may suffer alike and preference be given to none.

The principal point stated why the complainant had no good cause to recover damages is that the filling of the contract would require the defendant to break provisions of the Irrigation Law as may be seen from the following abstract of the decision:

"A contract which by its terms exacts a violation of the

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law will not subject the defaulting party to damages. Nor are damages recoverable for the non-performance of a contract, which, while legal in its terms may not, from the circumstances of the case, be performed without violating the law. This would especially be true where the contract is based upon a statute which, by its terms, provides for contingencies that would make the performance of the contract illegal. This would be true whether or not the violation of the statute was penalized. It may be said with a degree of accuracy that this would be true of contracts made by public-service or quasi-public corporations in the absence of any particular statute of inhibition, upon the general principle of public policy, which demands like treatment at the hands of such corporations toward all citizens and which places the ban upon discrimination."

We agree fully with this reasoning and will dwell for a few moments upon the queer contract that the parties thereto had entered into, namely the provision that sufficient water be supplied to the Rice Company's land to produce a stipulated minimum crop.

It would seem that in this age of progress and enlightenment such contracts would be a thing of the past as the resulting crop would depend on many other factors that are not under the control of the party furnishing the water, and the case under consideration is teaching a lesson that people when making contracts must steer clear of absurdities or infraction of the laws. If the Rice Company, instead of insisting on a certain number of sacks of rice per acre, would have entered a clause into its contract with the Water Company that the latter was to receive a certain bonus if the yield would exceed a certain minimum per annum, and another clause that the Water Company should grant a certain abatement of the charges per acre when the yield per acre would drop below a certain minimum, due to an insufficient supply of water, then the contract would have been based on more equitable facts and would no doubt have affected the rulings of the court.

No contract should be drawn the terms of which would interfere with the interests of other people or are contrary to the laws of nation or against common sense.

It seems that the Raymond Company should have some relief for the reason that if the Water Company was unable to furnish the water required by the defendant, then the Water Company should not be entitled to the full amount of charges per acre, as it seems equitable that if the patrons of the Water Company must suffer on account of the shortage of water then the Water Company should be made to help bear that burden by remitting a just proportion of the charges.

But all these points should be made part of a contract in the beginning as it would save expensive litigation later on.

A Move In the Right Direction

There is a petition now before the legislature of New Mexico to secure an appropriation for the employment of experts in the various irrigation districts of the state to teach the farmer the value of water and how to secure the maximum benefits from its use. There is now enough water wasted in the various states of the irrigated zone to double the acreage under cultivation with better results. For this reason the engagement of a number of experts who would travel back and forth along the various irrigation projects and give lectures and practical illustrations to resident settlers should be approved and the necessary funds provided. This movement should be the more supported for the reason that the United States Department

of Agriculture will supplement such State Appropriation with an equal amount from the federal treasury.

We understand that the State of California spends now \$3,000 and the State of Idaho \$7,000 per annum for this purpose and that the results show tremendous benefits in a practical way. Yet, a state as large as California and dependent on irrigation as much as that state is, should do a great deal more in this direction, and we trust it will be done in the near future.

There are, however, a large number of other states that should take notice and do likewise, namely, Oregon, Washington, Utah, Wyoming, Colorado, Montana, the Dakotas, Nebraska, Kansas, Oklahoma and Texas. With the co-operation of the government the great problem of modern times to make two blades of grass grow where now grows but one, may thus be solved successfully and the states interested will be enormously benefitted.

Modern irrigation is a new art based upon scientific principles and the only way to obtain best results is by educating the practical irrigator on his home ground. He needs to be shown how to do it and the reason why; then he will do the rest and do it right. The Department of Agriculture of the United States is working hard in this direction but it is the duty of the various state governments to co-operate with it and to bear its share of the expenses.

Let us have by all means travelling experts on irrigation, drainage and general farming, in order to bring the standard of the American farmer to the highest level attainable.

Factors Affecting Advertising Values

Advertising as a business proposition has become an established fact, and is an institution which has come to stay; it is an indispensable auxiliary to almost every business and it is therefore important that it be handled in the proper way.

Most advertising is done through the medium of the press and practically all papers carry advertisements, be they daily, weekly or monthly publications.

The purpose back of the advertising is to reach through the readers of these papers the parties who are interested in the subject which is being advertised, or perhaps more concisely to reach the parties who most likely will buy the advertised commodity.

In this way the various business houses select naturally such papers as are being read by their patrons regularly and gauge the value of the advertising medium by the number of readers which is presumably equal to the number of subscribers.

When it comes, however, to specialties in which only a certain class of people is interested, then the selection of the proper advertising medium must necessarily fall upon papers representing that class of readers and the value of such advertising does not depend so much on the quantity of readers, but on the quality, or, in other words, when a firm has a specialty for sale, for instance a special machine for making ditches, then the principal object of the advertisement is to reach *prospective buyers*.

Among the modern lines of business which are forging to the front, irrigation is perhaps one of the most important; it is growing rapidly, not only in America but in foreign countries, and many of the projects require heavy and costly machinery for their development. In the manufacture of this machinery the United States are leading the world and, as a consequence, the products of the American manufacturer are bought and shipped all over the world. This is due to

judicious advertising in journals reaching such readers in foreign countries in need of the machinery referred to.

THE IRRIGATION AGE is fortunate in having such a circulation which reaches clear around the world, and while the great majority of its readers live in the United States and Canada, we have readers in Australia, East India, Russia, Africa and other foreign countries. These readers are usually influential and responsible heads of irrigation or drainage projects, who, through the medium of our paper, become acquainted with the manufacturers of machinery in the United States and thus a way is paved for business relations which frequently result in the buying of thousands of dollars worth of machinery, which is sent abroad and, of course, pays the manufacturer handsomely for the cost of advertisement which brought him the business.

Thus it is seen that mere numbers of reader's or subscribers cannot be taken as a criterion on the value of a publication as an advertising medium; it is results the advertiser is after and results are always obtained by those who patronize the advertising columns of THE IRRIGATION AGE.

Wanted An Automatic Horse

Modern progress has evolved machinery that is wonderful and has done much for the farmer in giving him improved tools for the cultivation of his fields and for the harvesting of his crops. It has given him powerful tractors, where one engine will do the work of fifty or

more horses, engines that pull many plows at one fell swoop.

But the little farmer and settler whose holdings do not warrant machinery on this scale is left out. He still is compelled to cling to the horse for his motive power in his farming operations, and a horse is an expensive animal, especially in countries where, due to bad weather or cold winters, he is idle half the year or so. The feed of an idle horse is an important factor, and if it be possible to produce a gasoline tractor of one or two horse-power that will do the work of horses a great step will then have been taken forward in the direction of national economy and the success of the small farm units will be practically assured.

Such an engine should be made very strong so it could stand rough usage; very simple, so anyone with ordinary intelligence could run it, and at a reasonable cost so anyone of the small farmers would be able to buy it. The machine should be compact so that it can be used in narrow lanes and can turn short corners; it should be made so that it can be hitched to a plow or wagon and can be regulated by reins from the plow or wagon similar to the horse. It should be adaptable to be hitched to the pump to do the necessary pumping, to the circular saw to cut the fire wood, to the sewing machine and to the dynamo to generate electricity for lights at night.

An automatic horse of this kind would be the greatest boon in the way of machinery that can be conferred upon the small farmer and would be a powerful factor in developing many small farms which are now idle because of the higher relative cost of operating them.

Helping the Small Farmer

It is currently reported that Julius Rosenwald, president of the big mail-order house of Sears, Roebuck & Co., Chicago, has formulated a plan to spend one million dollars to help the cause of the farmer and particularly the cause of Intensive Farming, or the small

farmer. An immediate gift of \$100,000 is contemplated to be used in a hundred counties through the west for the betterment of agricultural conditions pertaining to these counties. All the details of the plan have, however, not been worked

out as yet, but it shows that large business interests begin to see the necessity of assisting the small farmer by teaching him how to make use of modern and improved methods in order to harvest better crops and thus give him a greater measure of prosperity.

It is stated that the plan contemplates that this financial aid will be given to counties only where other moneys are raised for the same purpose from other sources.

It would seem that such efforts should be carefully planned and executed according to a well-developed general idea in doing the most good to the greatest number and that they ought to work in conjunction with the machinery of the Agricultural Department, which has done so much in this direction during late years; such private aid to advance the cause of farming should be turned over to this department directly, for it to disburse it systematically in a general advance along all lines of agriculture rather than to concentrate special help in a few chosen counties or localities.

The Lessons of the Titanic

The awful catastrophe which took place in the early morning hours of April 14th, when the White Star liner Titanic, after a collision with an iceberg, went to the bottom of the ocean carrying about 1,500 people down with her to a watery grave, has stirred up humanity from one end of the world to another.

That such a calamity should have befallen a vessel which was considered the crown of modern nautical architecture was hardly believed until no further doubt was possible.

It is even now somewhat early to pass judgment in the matter and to place the responsibility for this terrible thing—with the facts now established after a thorough inquiry it may be said that the fault cannot be laid at the door of any individual alone nor yet at the door of the corporation alone, but that our modern civilization itself must bear a heavy share of the burden of responsibility. We are living in a record-breaking age; the Titanic was the largest vessel afloat, and it had been designed to be at the same time the speediest. Of course the traveling public wants speed and wants broken records, and so the White Star line should not be censured too harshly in wishing that the new sea monster should beat all previous records in time from England to New York. That instructions to this effect had been given to the captain and that a director of the line was on the Titanic to see that the time schedule be shortened there seems to be no doubt; and had the trip occurred two months later such would, no doubt, have been then an accomplished fact, and the praises of the Titanic and its progressive owners would have been heralded far and wide.

But as a matter of fact the shortest line between England and New York lies close to the Banks of Newfoundland, in whose vicinity there is an abundance of ice fields and icebergs during the winter and spring, which, per se, should have been a danger sign for the Titanic when its officers decided to take the shortest route. If they had not taken the shortest route they could not have broken the record, hence no fault can be found with the officers for that. But now we reach a point where the captain of the boat must be censured, for word was sent to the Titanic by other vessels that there were dangerous ice fields and icebergs ahead; he should at this juncture ordered a reduction in speed and a sharp lookout for the dangerous floating bergs. No one perhaps will ever know whether or not Captain Smith made such suggestion to Mr. Ismay, the representative of the transportation line, but since the boat kept up its speed it shows that the warnings were disregarded. This speed was kept up during the fatal night.

practically up to the time the lookout sent his warning, with the iceberg one-quarter of a mile ahead. Here we observe that if the Titanic had been equipped with searchlights the dangerous iceberg might have been discovered at a distance of two miles or more, since the air was clear; that would have given the officer on watch a chance to steer clear of the danger. Another point we desire to call attention to is the fact that if the boat had been making a speed of ten or twelve knots per hour, the collision, if it had occurred at all, would have been unable to destroy so staunch a vessel as the Titanic, as the destructive force of colliding bodies grows as the square of the distance; thus, the impact at a speed of twenty-three knots per hour is four times as great as that due to a speed of eleven and one-half knots per hour. Thus it seems unpardonable for the officers of the Titanic to continue the terrific speed during the night when no searchlights were available, and when the lookout was unable to see ahead more than two boat lengths. The only excuse that can be offered for the action of the officers is that they were practically convinced that the Titanic was indestructible and unsinkable.

And, after the collision with the iceberg, when it became apparent that the vessel was doomed, the fact also appeared that there were barely lifeboats enough to save one-third of the ship's passengers and crew. This is the most appalling of the tragic facts connected with the terrible catastrophe; a magnificent boat accommodating 2,500 people, yet having only lifeboats enough for one-third that number. Not a soul would have been lost had the provisions for shipwreck been sufficient. And so nearly 1,600 persons perished for the want of lifeboats.

The inquiry further develops the astonishing fact that, according to the Board of Trade rules of England, the builders of the Titanic had conformed to all the laws, rules and requirements of that body.

Great calamities teach important lessons and the first one is, no doubt, that every vessel should be equipped with sufficient lifeboats to hold the maximum number of passengers and crew.

Then all ships should be equipped with searchlights and wireless telegraphic apparatus. Compulsory reduction of speed in waters where dangerous obstructions may be encountered. These requirements should be rigidly enforced by law. There are, however, other lessons which the thinking world should ponder over: Are we not going a little too fast? Have we not reached about the limit in the size and speed of modern steamships, and perhaps also in the speed of our modern limited trains? And as these features of modern progress are the result of popular demand, why, then, should not the public be indicted as a party responsible for so many fatal accidents. Truly, it is time to make a survey in our onward march of the dizzy heights we are attaining and see whether we are giving the factor of safety due consideration.

SIPHONING OF WATER IN IRRIGATION.

It has been demonstrated to the entire satisfaction of the writer on the Twin Falls North Side Project, that the siphoning of water for irrigation, does away with much of the continual worry and hard work incident to watering new land. I do not know whether this method of watering has been tried to any great extent in other projects, but numerous ranchers on this project are using siphons quite extensively, and much to their benefit.

It is quite a serious problem to handle the loose lava ash soil we have to contend with, and many systems of irrigating have been resorted to, namely: lath boxes, galvanized tubes, sod, etc., but the siphon method seems to possess some very good advantages over the other methods.

The method pursued in using these siphons is to use

only one ditch, making the ditch of such a construction as to raise the water several inches above the ground to be watered. The siphons consist of three-quarter or one-half inch iron pipe, about four to five feet long. The ends are slightly bent, and then the remainder bent over a wagon wheel, making them semi-cylindrical. A pipe is used for each corrugation, and after the water is once started through the tubes, the flow can easily be regulated, but raising the end in the corrugation higher to give a less flow, or lowering it again to give an increased flow.

The one great advantage in this system is the use of only one ditch. Land is not cut up by the use of sub ditches. Of course, this method means additional check boxes, for it is necessary that the water be almost on a dead level in the ditches, and if the ground is steep, many checks are necessary to accomplish the result of getting the water on a dead level so that it will always be at the top of the ditch. This method of irrigating requires less water. One can make use of every drop of water coming down a ditch, with a minimum amount of waste.

The essential thing is to have the ditches in the best of shape, and I find there is only one satisfactory way to do it outside of using a 20th Century Grader, and that is to plow several furrows with a turning plow, and then get in with a shovel, and shovel the loose dirt on the bank, building it up good and solid, and tramping it well, making the ditch bank five or six inches above the ground to be watered. With ditches in proper shape, and checks placed correctly to give an almost dead flow to the water, the question of starting the siphons is a very little matter. They can be started by filling with water, or a tube made to fit the end of the pipe, and sucking the water through the pipe to get it started. Under favorable conditions, one ought to start 200 of these tubes in an hour's time.

I have been so favorably impressed with the work these siphons have done for me this season that I intend to irrigate my entire acreage with them. I have 250 of them now in use with a supply on the way. It would pay anyone to try this method where they have been experiencing trouble in handling loose soil.

FRANK S. REID,

Helen-Mae Ranch, Wendell, Idaho.

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Everybody interested in hay presses and bailers should send and get Whitman's big new catalog. It shows all that is best in hay presses and bailers. These new improved presses are great labor, time and money savers. This catalog will be sent free to anyone mentioning our paper. Write for one today. Their address is Whitman Agricultural Co., 6962 Broadway, St. Louis, Mo.

A PROGRESSIVE RAILWAY.

The *Rio Grande Service Gazette*, issued monthly by the passenger department of the Denver & Rio Grande Railroad, is a bright and interesting little paper of four pages giving all the items of railway news pertaining to all of the employees of the Denver and Rio Grande Railway System. The copy before us is the April, 1912 issue and is No. 4 of Volume II; it is brimful of useful information not only for the employees of the railway but also for all others living within the sphere of influences of that progressive road, which applies to the states of Colorado, New Mexico, Utah, Nevada and California.

The "*Rio Grande Service Gazette*" is a move in the right direction, worthy to be emulated by other railway companies.

Mr. J. B. Adatte, who has represented the IRRIGATION AGE in Colorado and New Mexico, is no longer connected with this publication. Any business that is to be transacted with the IRRIGATION AGE in that territory should be addressed directly to this office.

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SALT RIVER VALLEY

An Object-Lesson in Governmental Reclamation*

By EDWARD F. BOHM, Author of

"The Carey Act Manual" and "Papers on Irrigation Finance"

The writer of conservative tendencies, in an attempt to describe, in the columns of a semi-technical journal, the Salt River Valley of today, must approach his task with some degree of hesitancy. So much has been set before the public upon this subject during the past decade that much to be written at this time will bear the earmarks of a twice-told tale. Beyond this, it is difficult, even for the scientifically trained observer, to divorce from such a discussion every tinge of that natural enthusiasm which is bound to infect him who has been privileged to witness the marvelous fruition of one of the first of those great twentieth century experiments in Governmental home-making—the "Federal Reclamation Projects." A drama of interest, absorbing to the layman, as well as to the devotees of many professions and sciences, was inaugurated with the final official approval of the project ten years ago—a fitting prologue to which may be found in the exhaustive researches conducted by Federal and Territorial "Departments" for many years prior to that time—investigations covering every one of the manifold phases of the titanic scheme of the permanent and lasting reclamation of a desert area of 25,000 acres. The records of the Territorial University at Tucson, of the Departments of the Interior and of Agriculture, bear evidence to the successful attainments to disclose the secrets of nature and to build the proud system of water delivery as now completed upon such a foundation of absolute knowledge as would forever insure its permanency and adequacy.

The Governmental publications upon these subjects are many and exhaustive, and those desiring to engage in a more detailed study of the project would do well to consult the records of the U. S. Geological Survey, the Reclamation Service, the Bureau of Soils and the Weather Bureau. The first act of the drama—that of construction—has almost closed, the project having been officially reported (April 1st, 1912) "93½ per cent completed," but an era of even more transcendent interest and importance has been opened—the era of "development and home-building." Much has been written, since the time of Ferdinand La Salle, countless theories evolved for the betterment of living conditions of the human race, not to exclude mention of Roosevelt's famous "Country Life Commission." Sociologists of late years have universally recognized that the ideal community of the future must embrace, in well-balanced proportion, the advantages of urban as well as of rural life. It would be an easy matter to present a treatise upon the sociological aspect of Government Reclamation—of the effect of the breaking up of large land holdings into small units; of the almost ideal conditions of life made possible by the application of the doctrine of a "little land"—in a practical way, but such discussion, interesting as it may be, must remain outside the limits of such an article as this.

These subjects have been well and sympathetically treated by students, writers and lecturers—among the best contributions may be mentioned those of Mr. C. J. Blanchard, statistician of

the Reclamation Service and B. A. Fowler of Phoenix, former president of the National Irrigation Congress.

It is recognized that a peculiar responsibility rests upon the publisher of a magazine devoted to the technique of an industry or profession and it is not wrong to assume that the readers of such a publication have a very natural right to expect that its utterances in themselves shall constitute an authority of measurable weight. With this conviction it is believed that the readers of the IRRIGATION AGE will have better reason to be satisfied with a presentation of cold, hard facts summarized after the manner of an "Official Report" than with an elaborate attempt at word-painting. In the final conclusion it is not to be expected that any one will be persuaded blindly to invest without personal investigation—the series of articles of which this constitutes the second is, after all, intended only as a guide to those districts which, in the unprejudiced opinion of the writer, are of such a substantial degree of merit as to warrant the outlay of time and money necessary to the personal choice of a home. As a preliminary to the description to follow, it will be well to take note of certain popular misconceptions, or failures to conceive, especially upon the part of the average Eastern mind.

"WHAT IS A WATER RIGHT?"

Since irrigation became a factor of importance in agriculture, the question of what constitutes a water right has received consideration and various interpretations have been placed upon the phrase. In America, the question—at first purely academic with increased pressure upon existing normal flow of streams early became of practical importance. Courts and laymen have supplied answers of varying tenor in the past, but, with a few notable exceptions, the prevailing conception of a water right is that incorporated in the Federal Reclamation Act, in the Irrigation codes of a number of the states and as aptly defined by the statutes of Wyoming (S. L. 1909, Ch. 68, Art. 1). "A water right is a right to use the water of the state when such use has been acquired by the beneficial application of water under the laws of the state relating thereto. Beneficial use shall be the basis, the measure and limit of the right to use water at all times, not exceeding in any case the statutory limit of volume. Water rights can not be detached from the lands, place or purpose for which acquired, without loss of priority."



Irrigating Canal, Salt River Project, Arizona.

*EDITOR'S NOTE: This group of articles is the second of a series by Mr. Bohm begun in the March issue of THE IRRIGATION AGE and further contributions to which will appear from time to time. Mr. Bohm's standing as an authoritative writer upon irrigation topics is such that he does not require an introduction to our readers. None but districts or projects of demonstrated merit will be described, the policy of THE IRRIGATION AGE being to make these articles sources of real information and assistance to those interested.

As we have to deal, in this instance, with the operations of a Federal project, it is important that a true conception of the character of the "Water Right," i. e., "Right to the use of water," be had. Section 8 of the Reclamation Act provides inter alii, "That the right to the use of water acquired under the provisions of this act shall be appurtenant to the land irrigated and beneficial use shall be the basis, the measure and the limit of the right."

Let us make clear just what this means, in a practical way. The significance of it is that each and every tract that is "signed up" (pledged to secure the lien of the Government for repayment of its proportionate share of the cost of construction) has a valid and indefeasible right to its pro-rata share of the water available, so long as the statutory and contractual conditions of the Government as complied with, whether the tract embraces five or 160 acres. What amount of water shall this represent in concrete figures? To the average western man, this question will appear capable of easy answer, but the importance of the subject seems to warrant some explanation, and the answer involves consideration of the so-called "duty" of water. It must be remembered that portions of the valley have been irrigated—not only in prehistoric times, as the remains of ancient ditches abundantly testify, but during the era of which we treat—the first ditch having been "taken out" in 1867. Extension of cultivation and irrigation continued rapidly, settlers being attracted by the manifold advantages of soil and climate. During all the period prior to the construction of the Roosevelt dam and reservoir, irrigation (excluding the relatively small area served by pumping the underflow in the valley), was dependent entirely upon the caprice of the Salt River and its tributary. How erratic this flow from month to month, and how great its volume in the aggregate, is set forth in interesting fashion in the records of the Geological Survey, covering a period of a quarter-century. This extension resulted in over-appropriation of the dependable surface supply from the river and consequent distress for the later ditches. The earlier "priorities" were later decreed the rights to which entitled, by the local courts, upon the universally established principle of "first in time, first in right," and, as a rule, these rights were of tangible value exactly in proportion to the duration, seasonal variation, and amount of flow of the stream. A few of the very early ditches with decreed rights to the regular flow of the stream—adequate even under present conditions, are not embraced in the Federal project, and are independent of its operation—the so-called "Tempe" canal in the vicinity of Tempe being an example.

Parenthetically, it may be explained that it was this condition that forced the agitation for the much-needed storage of water and equalization of flow. The existence of so large an acreage under ditch without a dependable supply of water—of the great area of land of tremendous potential value—the recognition of the inherent advantages of the valley, were all of them factors in deciding the location of government activity.

This historical digression is made to show that agriculture had been carried on in the valley during a period extended enough to demonstrate the water needs of varying crops and soils as expressed in the unit of measurement in vogue today, the acre-foot, i. e., water enough to cover an acre one foot deep. Let us assume the average depth for the entire valley with cultivation carried on 365 days in the year as four acre-feet—that would represent the amount to which the holder of a "water right" were entitled—the maximum amount. How would the application of this principle operate as applied to conditions existing at the present time? The total area to be served is 240,000 acres, of which 40,000 acres are to be supplied by pumping—leaving a residue of 200,000 acres to be served by gravity or "surface" flow. The capacity of the reservoir is 1,284,000 acre-feet, or in excess of 6 acre-feet to every acre of land to be served by gravity embraced in the project. Now it is a fact that only during a part of the year will it be necessary to draw upon this reserve of stored water as the normal flow of the Salt River and of the Verde River (discharging into the Salt River below the reservoir) available for direct distribution is, at certain periods, of tremendous volume, and far in excess of the needs of the entire project. It is entirely safe to assume that when the time arrives when every irrigable acre in the valley is under cultivation, the draft upon the stored water (disregarding the small factor of evaporation loss) under normal conditions of river flow will not exceed a possible one-third of the total available. But there is another factor well understood by practical irrigators. It is this—as the irrigated area is extended, with the raising of the ground-water-level with improved cultured methods and more scientific distribution, the "duty" of water increases—in other words, less is required than at the beginning. It is not unreasonable to believe that the "duty" of water in the valley may in time be raised to 3 acre-feet per annum—equivalent to 36 inches of rainfall, applied when and where needed—not at the whim of the elements. This, then, is the meaning of a "water right" in this valley, that the holder of such a right has a perpetual title to enough water for his needs, but under the enlightened system prevailing, for no more; "beneficial use being the basis, the measure and the limit of the right" he may not flood his land at will, to the detriment not only of his own but his neighbor's possessions. This "right" is not a fiction. If an analogy be required, it is like that of a shareholder in a bank with a strong reserve, for back of every acre, as a perpetual safeguard against drouth, lies the almost inconceivably vast store of water in the reservoir—an amount sufficient to inundate the entire project to a depth of six feet, if evenly distributed. This water right means even more—it means that the holder is a proportionate prospective owner of the monumental plant now built at a cost of ten millions of dollars—a plant that, unlike most industrial "plants," will continually increase in value as canals and laterals become

"seasoned"—a plant which he and his fellows are acquiring at actual cost—the Government has figured no profits on construction—has even discounted interest charges—a plant with which is combined a feature that, even now, commercially considered, is earning dividends, although indirectly distributed—the sale of electricity generated at the immense power stations embraced by the system. This grand system—the product of years of thought and of Herculean effort, will, when all payments to the Government have been completed, become the property of the holders of "water rights" in fee, with all its revenue-producing possibilities, and the "right" represents an equitable interest in a property of which not only the physical valuation will increase, but the earning possibilities of which, for irrigation and power, can hardly be conjectured. It is a "right" that cannot, like a share of stock, as is possible in some communities, be held "in suspense" or apart from land for speculative purposes, but it is, and must forever remain attached and appurtenant to the land to which decreed. Can a more perfect method of procedure be conceived? The Government, it should be remarked, does not deal with the individual



Cattle on Alfalfa in Salt River Valley, Arizona.

directly—its contracts and agreements are made with the "Water Users' Association," a member of which every land owner, before receiving water from the project, must become.

THE VALUE OF A "WATER RIGHT."

The cost of this asset of immense potential value, has not at date of this writing been definitely established. It will not exceed \$50 per acre or be less than \$40, payable in small annual installments without interest. No one may guess the future value of such a "right." Water rights are, in some senses, analogous to market securities, their selling value being based upon security of principle, strength of reserve, earning power and market ability. It is true that a government water right is not a merchantable commodity separable from the land, yet it is the opinion of the writer that the "Rights" in this valley, within a measurable period, will be of a value infinitely greater than that of the very cream of the land, considered by itself. What is a "right" worth? Whatever it will "fetch." A little over a year ago the City of Grand Junction, Colorado, upon condemnation proceedings, paid to certain ranchers for a few second-feet of decreed rights of earliest priority, from a small stream the sum of \$28,000 per second-foot, and this not for stored water but for a supply subject to the caprice of a running creek of perennial flow. It is recognized that this price was outside of the limits of agricultural value, but figured upon the same basis a water right to 4 acre-feet annually in the Salt River Valley would be worth not \$50.00 but \$1,600.00 per acre.

STATUS OF LANDS.

No one should enter this valley in the hope of securing "free" land or "Government Homesteads" under the project. There is no such land remaining—all government land having been filed upon long ago and no practicable means of irrigating any land outside of present ditch systems open to individual effort. Title to practically all the land embraced within the present ditch line passed from the government many years ago. A large proportion of the land upon the market now being embraced in the holding of a few large interests—great ranches belonging to individuals or corporations. Let it not be assumed that these interests are disposing of their so-called "excess holdings" voluntarily. On the contrary it is no reflection upon them to state that the great majority would prefer to remain in possession of the land, both for revenue purposes and the great increase in value that the future is bound to bring. The "answer" is to be found, again, in the Reclamation Act. Section 5 provides that "no right to the use of water for land in private ownership shall be sold for a tract exceeding 160 acres to anyone land owner and no such sale shall be made to any land owner unless he be an actual bona-fide resident on such land (the Department of the Interior has ruled that one may reside at a distance not exceeding 50 miles from his land) and no such right shall permanently attach until all payments therefor are made." The land companies are, under this contract with the government, bound to dispose of all their land holdings in excess of 160 acres at the earliest possible date and, as a rule, are offering the lands in tracts of any desired acreage at moderate figures.

GEOGRAPHIC—TRANSPORTATION—CULTURE, PAST AND PRESENT.

Location—south central Arizona in Maricopa County. The approximate length of the valley—east to west—to the Agua Fria River is 35 miles; its average width 15 miles. Irrigable area embraced in project—Gila Reservation 10,000 acres; outside of reserve—by pumping, 40,000—by gravity system 190,000 acres; total 240,000.

Railroads—Branches of the Southern Pacific and the Atchison, Topeka & Santa Fe systems penetrate all parts of the valley.

The soil of the level valley floor is naturally adapted to roadmaking and the absence of precipitation renders the maintenance of roads an extremely simple affair. The valley, so far as the present era is concerned, was first settled in 1867 and the influx since that time has been rapid. With the completion of the storage system, settlement has received a tremendous impetus. There is a number of flourishing cities and towns in the valley, Phoenix, the capital of Arizona, Tempe, Mesa, Glendale and Buckeye being the most important. The Reclamation Service reports (June 30, 1911) as follows: "Excellent progress has been made along all agricultural lines during the past year and a general feeling

of optimism prevails throughout the project. Irrigation is carried on during the whole year, there being two seasons—that of summer from June 1 to September 1, devoted mainly to the cultivation of alfalfa, garden truck, small fruits and sugar beets, and to dairying, and a winter season from October 1, to May 31, devoted mainly to the cultivation of alfalfa, grain and citrus fruits and to dairying. Of the acreage in cultivation 55 per cent is in alfalfa—30 per cent in grain, 8 per cent is in dairy pasture and the remainder is distributed over a wide range of products, including fruits, sugar beets and vegetables."

WATER SUPPLY.

Source of Water Supply—Salt and Verde rivers and wells in various parts of the valley. Exhaustive investigation of the underground waters of the valley have been made both as to quality and quantity. It has been determined that the amount needed to serve the 40,000 acres embraced within "pumping units" is well within the amount of annual accretions to the underground supplies, from river underflow alone and that the waters contain no salts in amount injurious to crops. The Court-House yard in Phoenix has been irrigated for 27 years with well-water alone, and the flora of its world-famed garden seems to offer conclusive evidence upon this point. There is hardly a place within the project where excellent water for domestic purposes cannot be secured at a moderate "lift."

PHYSICAL FEATURES OF SYSTEM.

Reservoir.—Located in bed of Salt River, about 80 miles upstream from Phoenix; area, 16,320 acres; capacity, 1,284,000 acre-feet; capable of large increase by adding a few feet to height of dam. *Dam.*—Maximum height 280 feet; length of crest, 1,170 feet. "Granite Reef" Diversion Dam about 30 miles upstream from Phoenix delivers water to canals on either side of the river. The aggregate of canals embraces a stupendous array of figures; 32 miles of capacity greater than 800 second-feet; 64 miles from 300 to 800 second-feet; 92 miles from 50 to 300 second feet; 366 miles of lesser capacity; tunnels 23; aggregate length two miles. *Water Power.*—ultimate development 18,650 horsepower; a vast number of structures of various kinds, headgates, checks, drops, pumping stations, bridges and buildings; steel and reinforced concrete being universally used, ensuring the maximum of efficiency with the minimum of maintenance expense. Of roads built by the "Service" 147 miles, telephone lines 145 miles; 48 telephones, 123 miles of electric transmission lines. All of the canals taken over by the Reclamation Service have been enlarged and improved to Service standards.

The sediment which is carried by the water in flood time is very important, not only on account of its fertilizing value but also because of its effect in changing the physical properties of the soil to which applied.

Section six of the Reclamation Act provides that when the payment required for the major portion of the lands irrigated are made, then the management and operation of such works shall pass to the owners of the lands irrigated—to be maintained at their expense, etc., consequently, at the present time (and for some time to come) the operation of the works remains under control of the Reclamation Service with its complete organization directed from headquarters at Phoenix. At the present time water is being delivered upon an acreage charge of \$1.60 per annum. The organization comprises the following named gentlemen: L. C. Hill, supervising engineer; C. H. Fitch, project engineer; H. S. Reed, engineer in charge of operation. It is eminently fair and deserved that a tribute be paid, at this time, to the staff of engineers and operatives of the Reclamation Service who are, in the last analysis, responsible for the successful culmination of this gigantic undertaking and to the enduring character of the work performed.

CLIMATOLOGICAL.

Much has been said in praise of the climate of the valley and much in disparagement. With regard to its effect upon the individual this must always remain a moot question of taste so far as the four hot months of the year are concerned. As to the balance of the year there is but one opinion upon the subject—"ideal" is the word commonly used to express it. It is just as well to face the situation calmly and without hysteria; the summers are undeniably hot during the day-time. The AGE holds no brief for the Salt river, or any other valley, and the writer's experience has fostered in him

the belief that a climatic "Utopia" does not exist anywhere. Personally, the writer would infinitely prefer the dry heat of Arizona to the summer heat of the Atlantic Seaboard or middle western states. Against the bold statement that it is, hot, as is borne out by official records, must be set the fact that people are continually emigrating from the so-called "temperate zones," taking up their residence here, surviving the summer heat, working in the fields in fact in broad daylight, and continually adding to their store of health and vitality; and that the nights are refreshingly cool. Everyone familiar with the effects of humidity or its absence upon radiation will grasp the reason for this and the fact that the sensible temperature is about 20 degrees less than the official. One of the pleasantest features of life in the Salt River Valley may be found in the slight wind movement. Cyclones are unknown and dust storms practically so. A light and almost constant breeze serves to mitigate the severities of the summer heat. From the agricultural standpoint climatic conditions are perfect, the heat with its largely imaginary terrors, is an undisguised blessing, its effect upon citrus fruits, alone, are manifest in the surpassing quality and flavor of Salt River oranges.

Observations of the U. S. Weather Bureau covering a period of many years, give the range of temperature as follows: "22 degrees to 117 degrees. Average humidity 35 per cent average wind movement $2\frac{1}{2}$ miles per hour; average precipitation 8 inches; average of daily sunshine 80 per cent. As to healthfulness there is no room for two opinions. Heat prostrations and enteric diseases are unknown. The valley, in common with all of Arizona, is a vast sanitarium, especially suited to the cure of pulmonary and bronchial affections." For further data consult "Climatological Summary of Southern Arizona," United States Weather Bureau, Washington, D. C.

SOIL.

The soils range from heavy adobe to gravelly river wash. Loess and sandy loam soils of great fertility constitute more than half the area, while gravelly loams and sands and less easily cultivated clay soils make up the remainder. The chief need of all these soils is organic matter and nitrogen, both of which are supplied by the principal crop—alfalfa. Alkali salts have been concentrated in a few isolated localities where the drainage is poor and where sub-irrigation has occurred through the action of irrigating waters. These districts are all susceptible to drainage, either by sumps and pumping or by tile and will be reclaimed, ultimately (the legislature at date of writing has before it a "Drainage District" law rendering possible co-operative drainage should it ever become necessary). An exhaustive soil survey has been made by the Bureau of Soils, and this, together with the topographic map of the Reclamation Service permits accurate determination of kind and quality of all lands in the valley.

FARM PRACTICE.

Land surfaces are very smooth, requiring little leveling and slope from less than 10 to as much as 20 feet to the mile. The average cost of bringing land under irrigation is therefore minimum. Alfalfa is thus far the most important crop. It yields five to six cuttings of hay, or, if desired, produces profitable crops of seed, or afford two to three months' pasturage, convertible into mutton, beef and dairy products, endures well both extremes of temperature and, with all this, enriches the soil for other crops, and therefore is perfectly adapted to the conditions and needs of the region. With alfalfa at \$10 per ton in the field, under present methods a net profit of \$40 to \$45 per acre per annum may be safely relied upon, the margin of profit at times being susceptible to great increase. Because of high prices for baled hay, often ranging to \$15 per ton in early spring, much is sold in that form although a large part of the crop is fed and handled in the form of beef. Dairying is profitable also and several creameries and one condensed milk factory afford markets for the product. Range sheep are prepared for market in increasing numbers on alfalfa, bees forage upon it for honey and even ostriches are satisfied with it as their main food staple. Citrus culture, orange, grape-fruit and lemons prospectively the most important fruit growing industry of the valley, is best suited to the slopes where frosts do not occur. The early ripening of oranges in the region is a very favorable circumstance, the first shipments often reaching eastern markets in time for the Thanksgiving table. The bright color and excellent quality of the fruit,

due both to climatic conditions and the absence of citrus pests, is another reason for the high prices which have been received for this product. The culture of oranges and pomelos, with assured water supply under the Roosevelt reservoir will expand greatly in those parts of the valley where winter temperatures permit. Cantaloupes are an established and remunerative crop and are marketed mainly in eastern cities, through growers' associations. Ostriches are an interesting and profitable novelty of recent development.

In brief, with an assured water supply, a remarkable diversity of profitable crops possible, and scientific and intensive agriculture already well under way, Salt River Valley is certain to make rapid advancement in agricultural practice and development.

Lands under the project are purchasable at \$75 to \$250 per acre, according to condition, character and locality. The present tendency is towards small farms and more intensive cultivation.*

Not the least important of the products of the valley are its famous horses, "Phoenix" light harness horses are known throughout America for beauty, speed and stamina.

MARKETS.

An almost perfect monopoly of the market throughout a radius of distribution of several hundred miles, due to natural geographic conditions, assures the valley a permanent and profitable market for its staples for all time. For its more remunerative products there is practically no limitation as to scope. The mining districts of the state, already great and continually expanding, together with the great range cattle industry will provide a market for an enormous amount of foodstuffs and forage. Melons and citrus fruits are marketed through the medium of Growers' Association in the large eastern cities, at top prices. Alfalfa and dairy products are in continual demand throughout southern Arizona and California.

DISTRICTS AND TOWNS.

The immense area embraced in the project (roughly about $10\frac{1}{2}$ townships) permits a diversity of topographic and soil features worthy of mention. No description of the valley may be regarded as complete which will ignore these facts or omit a mention of the various communities now established. The largest city in the valley, in the state in fact, the seat of the state government and of that of the county of Maricopa is

PHOENIX.

The population of Phoenix is now estimated at close to 18,000, with about 3,000 visitors added to this in the winter months. The remarks anent winter climate in the valley as a whole, throw light upon the reasons for this extraordinary influx of tourists. It has many attractions for the traveler and tourist and much to interest the archeologist and student of ancient races. The city has all improvements to be found in any well-developed community of the highest type; electric lights, adequate urban and interurban car service, sewer system, water supply of excellent quality, pumped from deep wells, paved streets and cement sidewalks. Churches of all denominations exist, many of them housed in extremely fine structures. The schools are modern and splendidly equipped. The Arizona School of Music is located here and is the means for supplying the needs of music lovers. Excellent hotels of the highest standard vie with a great number of handsome public buildings as attractions to the eye and as vehicles for dispensing comfort. The Y. M. C. A. of Phoenix is housed in a splendid structure costing \$125,000, with swimming pool and gymnasium completely equipped. The Carnegie Public Library is well stocked and much frequented. Among club buildings may be mentioned that of the Womens' Club, the Ingleside Club and the Country Club with their fine golf links, tennis courts and well-appointed grounds, and the Elks' Theater where many of the standard attrac-

*Note: For the above data upon "Soils" and "Farm Practice," the author is indebted to Professor R. H. Forbes, director of the Arizona Agricultural Station. A tabulated list of all fruits and vegetables adapted to be grown during each of the 12 months of the year as prepared by Prof. Forbes may be secured from any of the commercial bodies of the various districts enumerated herein. The list includes, besides the products named, strawberries, mulberries, blackberries, plums, apricots, peaches, figs, tomatoes, melons, lettuce, spinach, radishes, cauliflower, beets, turnips, cabbage, asparagus, carrots, onions, peas, green corn, potatoes, squash, string beans, apples, pears, grapes, almonds, dates, pomegranates, quince, olive, oranges, chilies, egg-plant, celery, together with a fair average yield of each per acre.

tions are staged by first-class stock companies and road troupes. A driving club has been organized and driving exhibitions are held throughout the winter at the splendid mile track at the Arizona Fair Grounds. The climatic conditions are exceptionally favorable for fast horses and many fine horses are quartered here during the racing season.

The Capitol building is a noteworthy sight while the garden surrounding it is famed the world over. The handsome and expensive building of the Water Users' Association and the Board of Trade are unique, but the chief and never-failing charm of Phoenix is to be found in its beautiful residence districts evincing in architectural design and in construction as well as in landscape setting the acme of refined good taste. The dwellings prettily established along the miles of excellent streets, avenues, and boulevards, each in its own large open space, set off with refreshingly green sod with ample and abundant shade from luxuriantly growing trees, and enlivened by the flora growing so abundantly in this climate the year round; there is no feature so attractive to the traveler and student as the home life of Phoenix—destitute of slums and poverty, where health and contentment, together with the means for supplying the most exacting requirements of refined life, make of existence alone, a delight. Beautiful drives over excellent oiled or macadamized roads make this valley the delight of the autoist, horseman and sightseer. The noteworthy scenic attractions in the valley and country adjacent thereto are many.

It will be seen that Phoenix is anything but a frontier town, and to the American cherishing a once popular delusion as to the "West" it may be well to point out that the Salt River Valley has been peopled largely by the very best stock of the East; by people of education and culture, and, in many instances, of wealth, attracted by many considerations. But Phoenix is far from being an "idlers' resort." It is a busy commercial metropolis. The school population is increasing at the rate of 15 per cent per year. Incidentally an apology is due for neglect to refer to the fact that children as well as horses and vegetables thrive wonderfully in the valley with its opportunities for open-air life the year around.

In 1911, six hundred and ninety new and substantial homes were erected. Five lines of railway, with eleven daily trains, now reach the valley and over 125 miles of new railway have been built in Maricopa county in the past four years. In the same period 48 miles of cement sidewalk and one mile of pavement, identical with that of Michigan avenue, Chicago, have been constructed without a cent of bonded indebtedness. In three years bank deposits have increased from \$2,600,000 to \$5,365,000. In two years business and public buildings costing over \$1,000,000 have been completed and there are today under construction, buildings of this character to cost \$500,000, and, at least, 150 new homes.

Within the "Reservoir District" over \$5,250,000 have been expended in school buildings including three modern and well-equipped high schools. These figures tell the story of a growth at once phenomenal and substantial, based upon the intrinsic merit of the surrounding country and its agricultural resources, the ultimate of all real progress.

Inquiries concerning the valley should be addressed to the Secretary of the Board of Trade, Phoenix, Arizona.

ENCOURAGING WORDS.

Ft. Sumner, N. M., May 2, 1912.

Mr. D. H. Anderson, Publisher,
IRRIGATION AGE.

Dear Sir:—Please change my address, when mailing THE IRRIGATION AGE, to Fort Sumner, N. M. Present address, 4700 Rockhill Road, Kansas City, Mo.

Whenever my subscription expires I'll be glad to renew for one year, as I think your paper is just what every irrigator ought to read.

Possibly it might interest some of your advertisers to know that I'm in the market for a pumping plant to lift 6,000 gallons per minute on a 15-foot lift, distillate to be used as fuel. I've written the I. H. C., Chicago, Ellis Engine Co., Detroit, and for flume Colorado S. T. P. & F. Co., Colorado Springs, addresses obtained from your paper.

Respectfully yours,

JOHN S. TAYLOR,
Ranch Properties and Irrigated Lands.

IMPROVEMENTS FOR THE COLUMBIA RIVER.

Resolutions urging Congress to appropriate \$1,000,000 a year to complete the Celilo locks in the Columbia River before the formal opening of the Panama Canal, were adopted at a convention at Pasco, Wash., April 15, when the Columbia and Snake Rivers Waterways Association, of Washington, Oregon and Idaho was organized, the next annual convention of which will meet at Lewiston, Idaho, the middle of April, 1913.

The report of the committee on resolutions was adopted as follows:

"It is the sense of the meeting that there be free tolls on coast-wise shipping through the Panama Canal. We urge that Congress appropriate at least \$1,000,000 a year to complete the Celilo locks before the Panama Canal is completed; believing that the sum would save the government \$750,000 in the cost of the construction of the Celilo locks and that the Inland Empire would reap immediate benefits from reduced freight rates."

The committee also urges the vice presidents and directors of the National Rivers and Harbors Congress to vote in favor of Spokane for the 1912 convention, saying that the Northwest is entitled to the meeting and that the members of the committee believe if the next annual congress is held in Spokane it would be for the best interest of the country as a whole.

Speaking of "The Needs of Our Union with Other Sections in Waterway Improvements," Professor Lyman said, among other things, that government engineers had reported it would cost only \$17,000,000 to make the Columbia River navigable from the Canadian border to the Pacific Ocean, whereas the government has already appropriated \$67,000,000 for improvements to the Ohio River and \$200,000,000 for the Mississippi River.

Two hundred and fifty-nine thousand square miles is the drainage area of the Columbia River, according to a bulletin on the surface water resources of the northwestern portion of the United States issued recently by the Geological Survey. The source of the river is in British Columbia and its basin occupies large areas in that province and in the states of Washington, Oregon, Nevada, Idaho and Montana. The basin contains several of the highest peaks in America and some of the most fertile valleys in the world.

The navigable waters of the Columbia River and its tributaries aggregate a length of 2,136 miles. Within the area drained are the largest forests in the world. Agriculturally the area ranges from the extremely arid region, where irrigation is essential, through the semi-arid country where dry farming and irrigation are practised side by side, to the humid country, which is arid during the summer. Within the drainage basin are at least 33½ per cent of the available water power in the United States, but development of this resource has scarcely begun.

Among the tributaries of the Columbia River are Clark Fork, occupying large areas in Idaho, Montana and British Columbia, and the Snake River, which has its origin in the Yellowstone Park region of Wyoming, traverses the southern portion of Idaho and Oregon, and it traverses long distances in the state of Oregon before it finally joins the parent stream. There also is the Spokane River, which joins the Columbia River at the confluence near old Fort Spokane.

TO WHOM IT MAY CONCERN.

Notice is hereby given to any one of those who have knowledge of money having been paid to O. E. Gwinne, who had charge of an exhibit for the IRRIGATION AGE at the Omaha Land Show, to send in such information so that we may enter their name on our subscription list as paid for full term for which receipt is held. Mr. Gwinne disappeared immediately after the Omaha Land Show and sent no record of the business transacted to us, hence this notice. The IRRIGATION AGE is desirous of furnishing all subscriptions or advertising space for which money has been paid to O. E. Gwinne or any other agent, of which we have no record.

YOU WILL NEED THIS BOOK.

The "Primer of Hydraulics" is the only book teaching Hydraulics in a practical way. Price \$2.50, cloth bound. THE IRRIGATION AGE, Chicago.

ARIZONA

Health, Wealth, Recreation, Education

By EDWARD F. BOHM

On Wednesday evening, February 14, 1912, there occurred upon the streets of Phoenix, Arizona, a dance which was unique in history of latter day Anglo-Saxon America and which might well be supposed to have had as a stage setting the pictured adobe of some city of one of our neighboring Latin-American Republics. The event marked the culmination of a day of festivity throughout Arizona in celebration of the achievement of that Statehood for which Arizona's sterling men and women had fought long and arduously. The sturdy Americanism typical of this youngest of States united with the efforts of the Commonwealth oldest in cultivation and civilization, had wrested from a long unwilling central government the prerogatives of full citizenship.

With the adoption of its Constitution—an analysis of which lack of space alone prevents, with the Legislature at date of writing, in session, the "Ship of State," to borrow a time-worn phrase, is in full sail.

Arizona! There is magic in the very name. What transcontinental traveler, journeying through the southwest, which one of our railroad writers has so aptly termed the "Land of Enchantment," gifted with a particle of the imagination which is presumed to distinguish man from the anthropoid, does not feel his blood course faster at mere mention of the name. There is something in the atmosphere, in its wierd and magical topography and natural architecture, in its tremendous vistas of another era when the world was young and creation, in another long out-lived phrase, in its making; in its sublimity, grand colorings, in its health-giving arid climate and its wide vistas which permit a breadth of view that makes for sturdiness of fibre. It is no secret why the aboriginal races of this country were at once brave and warlike and gifted with poetry and imagination. The same conditions that bred these qualities in the Indian are just as vigorously asserting themselves today in the work of evolving a race of superior men and women of a new civilization.

The entire state is a vast sanitarium for the afflicted, a fertile field of operations for the vigorous, a playground of inspiring proportions for the pleasure-seeker and the despair of the sight-seer and artist. What traveler has not cast longing eyes towards the wonderful region beyond the "Atchison" in the north—the vast Navajo Reservation with its tremendous canons—Del Muerto and De Chelly; its grandly colored cliffs, like the Navajo Churches just across the boundary; the Hopi Reservation with its painted desert; its lonely Indian mesa dwellings; the Indians themselves with their fantastic yet romantic ceremonial rites; the Grand Canon unfolding a picture of sublimity which cannot be matched this side of the hereafter; the wonderful and unexplored country north of it, the "Kaibab" and "Kanab"

plateaus. South of this railroad, the Petrified Forests, on both sides the superb Tusayan and Coconino National Forests embracing the inspiring country about Flagstaff; the San Francisco Mountains and the cliff dwellings, the Canon Diablo, the Juniper Mountains and Metwite Mountain. About Prescott is a country of wonderful natural charm and redolent with the wonders of nature and of antiquity—Point of Rocks—Montezuma's Well and Cliff Dwellings.

The Great National Forests further south and east of Prescott, Sitgreaves, Tonto, Crook and Apache, embracing the Apache and San Carlos Indian Reservations, offer opportunities for health-giving recreation in their mountain areas.

To the west of the Santa Fe, Prescott and Phoenix lines, lies a vast desert and open-range country, extending to the Colorado river, a large part of which is destined, eventually, to be converted into fertile agricultural lands with the advent of irrigation from the Colorado river.

The broken mountain chains characteristic of the central, western and southern part of the state are rich in minerals and their treasures are largely exploited, mining being one of the chief industries of the state.

Tributary to both the Atchison, Topeka & Santa Fe and Southern Pacific systems is the Salt River Valley, in itself a scenic attraction of rare value.

Entering the state from the east, via New Orleans and El Paso gateways, over the Southern Pacific, the eye is charmed with a diversity of scenery typical in itself, and in a degree different from that of the northern part of the state. Here are vistas of the inspiring Chiricahua, White-stone, Huachuca, Coronado, Santa Rita and Tucson mountains, while to the south of the railroad and further west, lies a great area of open-range country, diversified with detached masses and short chains of porphyry mountains,



Country Home Near Phoenix, Arizona.

whose jagged outlines and sublime coloring have never been adequately depicted.

A branch of the Southern Pacific main line runs from Bowie near the eastern boundary of the state, north and west through the Gila Valley and a rich mining country, to Phoenix. From Maricopa the Southern Pacific lines proceed north to Phoenix and westward into California, leaving the state at Yuma on the Colorado river, every mile of road presenting a constant picture of enchantment. The Great Casa Grande ruins (a natural monument) are reached from the station of Casa Grande on the Southern Pacific main line. This much for the tourist, be he health or pleasure seeker.

The state embraces the tremendous area of 114,000 square miles. It is 340 miles wide by 390 miles long at its extremities. It embraces altitudes ranging from 83 feet to 13,000 feet above sea level.

The population in 1910 was 20,500, which figure has probably been increased by 25,000 since that time. The leading industry, as yet, is mining, live stock raising second, and agriculture, a constantly increasing factor, ranking third.

Its system of educational and other institutions of a public nature is excellent and liberally endowed with funds, which, with a wise management of the great estate of lands, with which endowed under the "Enabling Act," will be

greatly augmented. The assessed valuation of property for taxation in 1911 was \$100,000,000, the real value not far from \$300,000,000. The year's production from the mines amounted to the fabulous sum of \$42,200,000.

Irrigation was practiced in Arizona by ancient people, ruins of ditches and reservoirs having been found in numerous river valleys; their character demonstrating that these aborigines possessed considerable skill in the art. Some of the present Indian tribes still exist largely from the products of irrigated farming. Irrigation upon the part of Europeans was practiced as early as 1732 in the vicinity of Tucson; the Americans receiving their first instructions from the early Mexican inhabitants.

Irrigation in the Salt River Valley began as early as 1867, on the upper Gila river in 1874. The development of irrigation from the Colorado river has been stunted owing to the erratic character of that stream. The practical completion of the gigantic government project at Yuma will remedy this condition for all time. The normal minimum flow of such streams as the Little Colorado, The Verde, San Pedro and Santa Cruz has all been absorbed by numerous little ranches. Figures are extant which indicate that irrigation in the State has progressed from 2,000 acres in 1854 to 228,000 acres (census of 1909).

Climatically the state may be regarded as being divided into two zones, the northern part of the state embracing altitude from 5,000 to 13,000 feet, the southern part, of lower altitudes, diminishing to sea level.

Precipitation ranges from 3.13 inches to an average maximum of over 20 inches at the higher stations. Seasonal distribution of rainfall varies widely over different portions of the state.

The daily range of temperature averages about 30 degrees F. and may reach 50 degrees F. Relative humidity is low, less than 10 per cent being often recorded. Sunshine percentages are high, over 80 per cent being the rule in southern Arizona. Wind movement is light, averaging from 2½ miles an hour at Phoenix to 7 miles at Prescott.

The dearth of vegetable covering in the desert region, the dry air and clear skies favor rapid radiation at night. All these factors make for ideal health conditions. Under the varying conditions of soil and climate crops of all kinds, ranging from those of the temperate zones to those of the tropics, can be grown successfully. A large trade in valley products is maintained with the thriving mining towns which consume large quantities of forage and food products, with southern California points. Kansas City and the eastern markets for fruits. Small, intensively cultivated areas, not infrequently yield values of \$100 to \$300 per acre. Live stock raising, ostrich breeding and beekeeping are profitable variations of farm practice.

In her standing forests of immense area, Arizona has one of its greatest resources, as yet but little exploited.

The land area of the state, roundly 73,000,000 acres, may be divided as follows: Military and Indian Reserves, 15,100,000 acres; National Forests, 14,000,000 acres; Railroad land grants, 2,141,000 acres; Spanish grants, 54,700 acres; in private ownership, 3,760,000 acres; unappropriated and unreserved, 39,273,000 acres; lands in National Forests and Indian reserves subject to Reclamation Service restrictions, 4,130,000 acres.

Under the "Enlarged Homestead" Act 26,657,000 acres have been designated. Railroad grant lands, especially those of the Santa Fe Pacific are subject to purchase. The method of disposing of the enormous grant of land under the "Enabling Act" has not been determined, but a bill has been introduced in the Legislature at this writing (H. B. 101) to provide for this.

Agriculturally, lands may be classified as irrigable, dry-farming, grazing, forest and waste lands.

Under the head of available surface water resources, reliable estimates place the amount of water available from the Colorado river (with storage) for land that can be reached, as around 9,000,000 acre-feet annually, which will serve 1,374,000 acres of land in Arizona, California and Mexico allowing a duty of 5½ acre-feet annually; from the Little Colorado 300,000 acre-feet, enough for 100,000 acres; the Salt River and Verde River are treated of in a separate article in this issue.

Storage of the flood waters of the Gila river appears to be beset with difficulties of a physical and administrative nature.

There are considerable areas in southern Arizona where ground waters are found within 50 feet of the surface. The subject of ground waters is being systematically studied by both the United States Geological Survey and the University of Tucson.

Such waters in quantity sufficient to make them of extended agricultural value have been found in the valleys of the Rillito, Gila, Salt, Agua, Fria, New and Hassayampa rivers, and in the Santa Cruz, San Pedro, Sulphur Springs and San Simon valleys. Sulphur Springs valley, particularly has proven a source of large ground-water supplies, valuable in dry-farming operations. These great bodies of ground-water have, for the most part, been drawn upon but little. Considering the all-year growing season and the diversity and value of crops much may, with reason, be expected in the direction of further extended irrigation by pumping.

There are three well defined artesian districts in the state, those of the San Pedro valley north of Benson, one in Graham county, between Pima and Solomonville and one at San Bernardino, 40 miles east of Bisbee. Artesian flows have been struck, also, in northern Arizona.

The modern idea of compulsory definition of vested rights in water and the acquirements of new rights under public supervision has not yet found expression in Arizona statutes. However, at date of writing, the following measures dealing with the subject of lands and water rights have been presented to the Legislature but not as yet enacted into law, viz.: H. B. 6 adopting the provision of the Carey Act; H. B. 9 with reference to leased territorial school lands; H. B. 101 and 126, for the disposition of State Institutional and school lands; S. B. 58, Appropriation for Arizona Experiment Station; S. B. 66, for the organization of Drainage Districts; S. B. 70, for the organization of Irrigation Districts; S. B. 150, to prevent the damage of public highways by water allowed to overflow such from ditches.

The future of Arizona is bright with promises, and with the enactment of the measure now pending, providing for the establishment of a permanent Bureau of Immigration and with the enlightenment of the American public upon the subject of its manifold resources and advantages, its future growth and development is assured.

*Note: For the data upon land and water resources the author is indebted, largely, to the splendid work of Professor R. H. Forbes, director of Arizona Experiment Station, entitled "Irrigation in Arizona," Bulletin 235, U. S. Department of Agriculture.

THE "BARTLETT-HEARD" RANCH DISTRICT.

This district, just outside of Phoenix, a point 2½ miles south of Phoenix marking the nearest boundary, to be accurate, embraces a large area originally belonging to the so-called "B-H Land & Cattle Company." It embraces, in round numbers, some 7,600 acres, a great part of it under intensive cultivation at this time, the history of the agricultural operations of this district dating back to the early '70s. These operations embraced what, in an agricultural district, even in the days of princely land-holdings, was phenomenal, a single farm six miles long and from one to three miles wide, cross-fenced, and with 4,000 acres planted to alfalfa, much of this crop, owing to its age and consequent sturdy growth being, at this time in great demand, owing to its prolific yield and excellent quality and freedom from foreign growth. The completion of the storage system has, under the operation of the Reclamation Act necessitated the disposal of this land to "bona-fide residents" (as explained under caption "Status of Lands"). At the time of writing, 4,500 acres of this domain have been subdivided into tracts of 10, 20, 40 and 80 acres. Upwards of 100 tracts have been sold, the average size being about 20 acres. The close proximity of these lands to Phoenix and their ease of access via the new \$100,000 concrete bridge over the Salt River has been a large factor in the quick disposal of these "excess holdings." The small acreage comprising the average tract has had the effect as has been many times predicted by advocates of government irrigation with restrictions as to land ownership, of making for the establishment of that ideal form of country life, the form of the future—small acreage. Capable of great revenue production, proximity to large centers of population, with its manifold advantages, absence of that isolation which is the apprehension of the city-bred man and the nightmare of many a "practical farmer" and, to no less degree, of his spouse. With many

modern conveniences made accessible and possible of attainment through increase of population per unit such as telephones, electric light and power, good schools, neighborhood association, such a type of community appears to offer the solution of the problem of sane living conditions. The soil of this District, as it is natural to expect when one considers that the first invaders of the Valley had before them the pick of the lands, is very fertile and exceptionally well drained. It is a fact, demonstrated beyond all cavil or experiment, that the intensive cultivation of a twenty-acre tract will support, in comfort, an ordinary family, and while alfalfa alone yields a good income, a combination of other crops and industries is vastly more profitable. The wholesale cultivation of so large a tract under scientific management has made possible a wide range of experiments demonstrating just what can be grown and accomplished. It has been proven that small fruits and berries and vegetables grow best within a belt of "Recos Sand" near Salt River, and practically upon the confines of Phoenix. The sand is also suitable for the production of nursery stock, one nursery having already been established. A little farther back from the river is a loamy soil heavier than the "Recos Sand," particularly adapted to alfalfa, dairying, grain and sugar beets. A number of excellent dairy herds are now owned by the settlers in this section. A little further back, near the foothills of the southern boundary of the valley, is a third belt of "Maricopa sandy loam" covering the greater part of the ranch. This is the ideal soil for intensive, diversified farming. It is especially good for deciduous and citrus fruits, lemons and alfalfa. The soil over this district is from 10 to 30 feet deep. It is a rich, alluvial deposit. The slope is easy from the foothills to the river. Date palms grow well in all parts of the district as well as eucalyptus.

This district embraces one of the proven citrus belts of the Salt River Valley, an orange and pamelio grove having been in successful operation for many years. As is well known, Arizona oranges command the highest prices in eastern markets because of their superior quality. As high as \$9.40 per box, wholesale, has been realized from a carload shipment.

Poultry raising is carried on with great success and many of the new settlers are deriving fine incomes from their flocks of chickens, ducks and turkeys.

As for dairying, about the only requisites are the cows and alfalfa. Excellent water for drinking purposes can be had from the underflow.

As pointed out, the settler in this district can proceed at once upon highly cultivated and already productive land.

Some typical examples are quoted: Wheat yielding as high as 2,000 lbs. to the acre sold at \$1.80 per cwt.; milo maize $1\frac{1}{2}$ tons to the acre at \$1.25 per cwt.; alfalfa 8 to 10 tons to the acre at \$10 to \$16 per ton.

The entire tract is diversified by trees set along the roadways, all of them old enough to have attained maturity, and this feature, together with the thousands of acres in cultivation gives to the district a finished appearance that is extremely grateful to the eye. The many beautiful and comfortable

homes already established attest to the high character of the "settler" now upon the ground.

Inquiries concerning this district should be addressed to the Bartlett-Heard Company, Phoenix, Arizona.

THE GLENDALE DISTRICT.

The town of Glendale is located upon the main line of the Santa Fe, Prescott & Phoenix Railway, eight miles north of Phoenix. It is also in hourly communication with the capitol city through the medium of the electric interurban line recently completed. The district tributary to the city lies under the great Arizona canal of the Reclamation project and is served by it. At Glendale is located the great plant of the Southwestern Sugar & Land Company, an important factor in the life of the community.

Extending in a belt some four miles wide, running through Glendale from the northeast to the southwest, is the famous Glendale Loess, of great depth and strength. It is easily worked, does not bake after irrigation, and is free from alkali salts in harmful quantities. It is well adapted to grain, general farming and the growing of grapes, and, to perfection, to sugar beets. It was this factor that determined the location of the plant of the Sugar Company at this place. In the company's land test, thirty tracts were planted to beets. The average yield for all of them was 19.67 tons per acre. One patch near Glendale yielded at the rate of 42 tons per acre.

The underground water of the district is especially good and free from injurious salts. The total area tributary to Glendale is around 40,000 acres, a large proportion of which belongs to the Sugar Company which, under the operations of the Reclamation Act, is forced to dispose of its "excess" holdings. This it is now doing upon liberal terms, at the same time assisting the settler by contracting for his output of beets. The town itself has an adequate water works, ice and electric light plant, good hotels, mercantile establishments and banks.

The Sugar Company announces that it will contract on either a flat rate or a percentage basis, for all beets that can be grown in the Salt River Valley, and that it stands prepared to build a second plant if necessary to accomplish this.

Inquiries should be addressed to the Secretary of the Board of Trade or to the Southwestern Sugar & Land Company, Glendale, Arizona.

THE MESA DISTRICT.

Mesa City is located in the eastern and highest part of the irrigable section of the Salt River Valley, sixteen miles east of Phoenix.

As is indicated by its name, the surrounding country is a high, level table-land and comprises a large body of splendid country that seems especially well adapted to the cultivation of all crops grown in the southwest.

This part of the valley was first settled in 1877 and 1878. From the small beginning made by the pioneers, the acreage of irrigable land has been extended to embrace 33,543 acres under present canal system, together with several thousand



Bartlett—Herd Blue Ribbon Winners: "Sino," Full-Blooded Percheron; "Morning Star," Registered Jack, Sweepstakes Winner, Arizona Fair, 1911.

more that will later be served by private pumping systems. Evidences of prehistoric cultivation of this district are abundant, pottery and crude implements of all kinds having been found in considerable quantity. Many people are of the opinion that the land has been leveled by these ancient people, they deeming it impossible that it would be left so nearly level by nature but, be that as it may, the fact remains that the land requires little labor to prepare it for irrigation, and that the crops repay bountifully for effort expended.

The town of Mesa has a population approximating 2,500 but this number, due to the rapid influx of settlers to the country tributary to it, is rapidly increasing. All modern conveniences and social advantages are found here such as city water works, gas and electric light. All the leading fraternal organizations are well represented. The broad, shady streets, beautiful homes and up-to-date school system make the town a particularly inviting residence place. The Evans School for boys, widely known, is established here.

Chandler, the new town now being laid out, is seven miles south of Mesa, the so-called "Chandler Ranch" lands being reached from Mesa.

Mesa is located upon the Arizona Eastern Railway, a subsidiary of the Southern Pacific, with numerous daily trains to Phoenix and, via Tempe, with all eastern and western points.

The highest land lies to the east of town and many horticulturists predict that it, eventually, will be the select orange belt of the valley.

The pumped water, delivered by the Reclamation Service, issues at a temperature of from 78 to 80 degrees and is a great factor in protecting trees and vegetables from winter frost.

Only in recent years have a few orange orchards come into bearing in this district, and these have passed through the dry and wet years common before the Reclamation Service made a permanent and steady water supply possible. As a result the trees left are those which have survived a process of elimination. Navel oranges have netted as high as \$3.55 per box, f. o. b. Mesa, and during the recent past have netted good interest returns upon a valuation of \$1,000 to \$3,000 per acre. This fruit reaches the eastern market in season to command top prices.

All kinds of deciduous fruits do well here as in all sections of the valley, barring cherries, which seem to require higher altitudes. Peach trees often bear from 100 to 150 lbs. of fruit the third season from planting and other fruits in proportion. Vegetables and grains do well in this section. Cabbage is shipped out in car lots. A great deal might be said about fruits, vegetables, grains, etc., but stock-raising in its various phases and alfalfa culture are staple industries in any country.

A co-operative dairy and ice plant has been in successful operation at Mesa for a number of years. It has been aptly said that "grass is the basis of agriculture." Marvelous yields of alfalfa are common in the Salt River Valley. Cuttings of 8 to 10 and even 14 tons per acre annually have been secured upon scientifically-tilled land. Among these rich and fertile fields, it may well be said that the Dairyman's paradise exists. Hundreds of farms today in the New England and mid-Atlantic states are operated as dairy farms at a loss to the owner. Twenty acres in Mesa Meadows will support more cows and make more for the owner than the best of the depleted farms of the east. To those who know the unfortunate condition of the dairy situation upon the worn-out farms, the Salt River Valley offers a change of condition and environment that may cause him, once seen, to believe that he, verily, has found the land of "Milk and Honey."

TEMPE DISTRICT.

The city of Tempe lies about eight miles south of Phoenix, being served by both the Southern Pacific main line from Phoenix and the so-called "Hayden" branch to Mesa, Chandler and Casaba, affording direct communication for all the district. It is the oldest settlement in the valley, yet lacks none of the elements of a progressive community, being equipped with all the conveniences characteristic of the average enterprising western community.

It is distinctly an agricultural town and a school town. With a splendid common school system and a Territorial

Normal school, Tempe's educational advantages are second to none. The percentage of grammar school graduates who enter and graduate from the High School is higher than anywhere else in the United States. This Normal School is conceded to be one of the best of its character in the country. Twenty teachers who are highly specialized along their various lines, are employed. Graduates are granted life certificates to teach in the schools of Arizona and in many western states it is unnecessary for the holder of a Tempe Normal Diploma to take an examination before being granted a certificate.

There are scores of beautiful homes in Tempe. People of independent means are attracted to the place by the educational advantages it offers their children, by its moral atmosphere and fine climate. Many have winter homes in Tempe, living there during the school term and elsewhere during the summer.

The population is now in the neighborhood of 3,000. There has been a steady increase, especially during the last five years.

Tempe's domestic water supply is one of the best in the valley. It is forced to the summit of "Tempe's Butte" and there stored until used. This gives a tremendous fire pressure, which combined with an excellent fire department, causes the insurance companies to give Tempe unusually low fire insurance rates.

The cost of living in Tempe is quite low, since so much of farm staples, fruit and poultry is produced in the immediate vicinity.

Churches and fraternal organizations are well represented.

The Pacific Creamery Company, manufacturers of condensed milk, and the Arizona Portland Cement Company are located at Tempe. With the advent of the creamery, dairying has come to be one of the principal industries. The company, at date of writing, is paying \$1.20 per cwt. for milk averaging four per cent butter fat, hence the profits are large. Reliable estimates place the average yield of a single cow at \$93.50 per annum. Dairy cows are fed almost exclusively upon alfalfa, to which this section is especially well adapted.

Within the last few years, the Tempe farmers have taken up the breeding of fine horses, importing a number of thoroughbred animals, with the result that now there are no finer farm horses in the world.

Over ten thousand range steers were fattened for beef in the vicinity of Tempe last year.

Cantaloupes and sugar beets are two of the most profitable crops grown. Like Arizona oranges, Arizona cantaloupes have a reputation in the east of being the best.

Several fine orange groves are located near Tempe as is also the largest date orchard in the United States, where over fifty varieties are grown, the demand for this fruit greatly exceeding the supply.

Bee-keeping is one of the industries for which the district is well fitted, and there are, perhaps, few places where so many bees are kept in so limited an area as is the case here. The production of honey is now, and has been for a number of years, an industry of no small importance. The business is fairly remunerative and large apiaries are the rule.

Ostrich-raising is also an industry, which, while requiring a fair investment of capital, yields abundant returns.

The city contains good hotels, stores and banks, while the subject of a tourist hotel to be erected upon the summit of Hayden Butte, 370 feet above the level of the valley, has been broached.

The irrigated district about Tempe is one of the few not embraced within the Government project. It is served by the Tempe Canal with one of the earliest "decreed rights" from the normal flow of the stream. The stream-bed at Tempe is of such a character that the underflow is forced to the surface with the result that there is always water in the stream at this point. This supply is supplemented by pumped water for late irrigation, the Tempe District embracing the zone of "low lift."

The advantages of this District from an agricultural standpoint are numerous and the city, as already pointed out, besides being a commercial community is, primarily an educational center. Inquiries concerning this district should be addressed to the Secretary of the Board of Trade, Tempe, Arizona.

THE PRIMER OF HYDRAULICS*

By FREDERICK A. SMITH, C. E.

XX. Ditch Tables and Their Application.

1. How to Use Them.

The following tables relate to a number of ditches with their hydraulic properties worked out; the factor $n = .025$ and the grades are shown at the head of the various tables. Since the mean velocity varies as the \sqrt{s} , everything else being equal, it is easy to form other tables from these

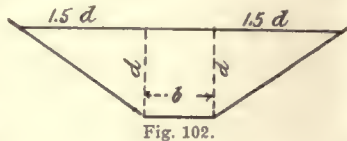


Fig. 102.

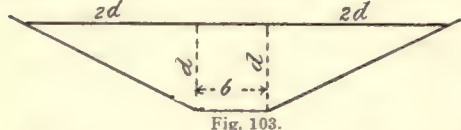


Fig. 103.

sired to prepare a table for a grade of 1 in 300, then the relation exists: $V : v = \sqrt{1:200} : \sqrt{1:300}$

$$V : v = \sqrt{.005} : \sqrt{.0033}$$

$$V : v = .07071 : .05746; \text{ hence}$$

$$V = \frac{.05746v}{.07071}$$

This gives the rule to find the mean velocity for any required grade; take the square root of this required grade and multiply with the given velocity; then divide by the square root of the given grade.

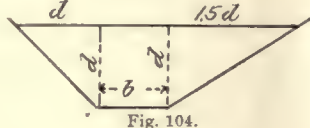


Fig. 104.

2. Table of Capacity of a Triangular Ditch, slope 1 to 1, see Fig. 96, and grade 1 in 400, $n = .025$, $s = .0025$, $\sqrt{s} = .05$.

Depth of flow	Flow area	Wetted Perimeter	Hyd. Rad.	r	\sqrt{r}	C	v	Cfs.	Gals. per min.
d	a								
.5	.25	1.414	.177	.42	.32	.67	.17	.76	
1.0	1.00	2.828	.353	.595	.41	1.22	1.22	548	
1.5	2.25	4.242	.531	.728	.46	1.67	3.76	1,687	
2.0	4.00	5.656	.706	.842	.50	2.10	8.40	3,770	
2.5	5.25	7.070	.882	.938	.53	2.49	13.07	5,865	
3.0	9.00	8.484	1.061	1.03	.56	2.88	25.92	11,633	
4.0	16.00	11.312	1.414	1.19	.60	3.57	57.12	25,636	
5.0	25.00	14.140	1.771	1.33	.62	4.12	103.00	46,226	
6.0	36.00	16.968	2.120	1.45	.66	4.78	172.08	77,198	

Depth of flow given in feet.

3. Rectangular ditch, with 2-ft. base, grade 1 in 200, $n = .025$, $s = .005$. (See Fig. 99.)

Depth	Flow area	W. P.	r	\sqrt{r}	C	v	Cfs.	Gals. per min.
flow.	area.							
6"	1.0	3.0	.33	.57	38	1.52	1.52	682
12"	2.0	4.0	.50	.72	44	2.22	4.44	1,993
18"	3.0	5.0	.60	.77	46	2.48	7.44	3,338
24"	4.0	6.0	.67	.82	49	2.81	11.24	5,036
36"	6.0	8.0	.75	.87	50	3.03	18.30	8,193
48"	8.0	10.0	.80	.90	52	3.28	26.24	11,776
72"	12.0	14.0	.86	.93	53	3.45	41.40	18,580
96"	16.0	18.0	.89	.94	54	3.55	56.80	25,490
120"	20.0	22.0	.91	.95	54	3.59	71.80	32,222

THE UNITED STATES LAND SHOW.

Mr. Robert P. Cross has recently accepted the position of General Manager of the United States Land Show and it is safe to predict that under his conservation and careful conduct the coming Land Shows will eclipse all others in the point of success. These exhibitions, which were founded in 1909 by the Chicago Tribune, have done a great deal of good in promoting the interest and development of America's agricultural resources and they will undoubtedly continue to do so in a greater degree under the management of Mr. Cross.

4. Rectangular ditch, with 4-ft. base, grade 1 in 200, $n = .025$, $s = .005$. (Fig. 99.)

Depth	Flow area	W. P.	r	\sqrt{r}	C	v	Cfs.	Gals. per min.
flow.	area.							
6"	2.0	5.0	.40	.63	42	1.85	3.70	1,660
12"	4.0	6.0	.67	.82	49	2.70	10.80	4,845
18"	6.0	7.0	.86	.93	53	3.45	20.70	9,290
24"	8.0	8.0	1.00	1.00	55	3.85	30.80	13,821
36"	12.0	10.0	1.20	1.10	57	4.39	52.68	23,643
48"	16.0	12.0	1.33	1.15	58	4.67	74.72	33,534
72"	24.0	16.0	1.50	1.22	61	5.20	124.80	44,662
96"	32.0	20.0	1.60	1.26	62	5.47	175.04	78,558
120"	40.0	24.0	1.67	1.29	63	5.69	227.60	102,148

5. Trapezoidal ditch, 1-ft. base, side slopes $\frac{1}{2}$ to 1, grade 1 in 200, $n = .025$, $s = .005$. (Fig. 100.)

Depth	Area	r	\sqrt{r}	W. P.	C	v	Cfs.	Gals. min.
6"	.63	.29	.54	2.12	38	1.44	.91	408
12"	1.5	.48	.69	3.12	45	2.17	3.25	1,458
18"	2.625	.60	.77	4.36	47	2.53	6.65	2,984
24"	4.00	.91	.95	5.48	53	3.53	14.12	6,337
36"	7.50	.97	.98	7.72	55	3.77	28.28	12,692
48"	12.00	1.20	1.10	9.96	57	4.39	52.67	23,638
72"	24.00	1.66	1.29	14.44	62	5.60	134.4	60,319
96"	40.00	2.11	1.45	18.92	65	6.60	264.0	113,990
120"	60.00	2.56	1.60	23.40	69	7.73	463.8	208,153

6. Trapezoidal ditch, base 1 ft., slope 1 to 1, grade 1 in 800, $n = .025$, $s = .00125$. (Fig. 101.)

Depth	Area	r	\sqrt{r}	W. P.	C	v	Cfs.	Gals. min.
6"	.75	.31	.56	2.41	38	.75	.56	251
12"	2.00	.53	.73	3.82	46	1.18	2.35	1,055
18"	3.75	.72	.85	5.23	50	1.49	5.58	2,491
24"	6.00	.91	.95	6.64	53	1.79	10.74	4,820
36"	12.00	1.26	1.12	9.46	57	2.24	26.84	12,046
48"	20.00	1.63	1.28	12.28	62	2.78	55.50	24,908
72"	42.00	2.34	1.53	17.92	67	3.59	150.78	69,685
96"	72.00	3.06	1.75	23.56	71	4.35	313.20	140,563
120"	110.00	3.77	1.94	29.20	74	5.02	552.20	247,827

7. Trapezoidal ditch, base 1 ft., slope $1\frac{1}{2}$ to 1, grade 1 in 200, $n = .025$, $s = .005$. (Fig. 102.)

Depth	Area	r	\sqrt{r}	W. P.	C	v	Cfs.	Gals. min.
6"	.88	.31	.56	2.80	38	1.43	1.25	561
12"	2.50	.54	.73	4.61	46	2.35	5.88	2,639
18"	4.87	.76	.87	6.41	50	3.05	14.85	6,661
24"	8.0	.98	.99	8.21	55	3.81	30.48	13,679
36"	16.5	1.39	1.18	11.83	60	4.96	81.90	36,756
48"	28.0	1.81	1.35	15.44	63	5.95	166.60	74,771
72"	60.0	2.64	1.62	22.66	70	7.94	476.40	213,809
96"	104.0	3.48	1.87	29.88	73	9.56	994.24	446,214
120"	160.0	4.31	2.08	37.10	75	10.92	1747.2	784,144

8. Trapezoidal ditch, width of base 4 ft., slope $1\frac{1}{2}$ to 1, grade 1 in 400, $n = .025$, $s = .0025$. (Fig. 102.)

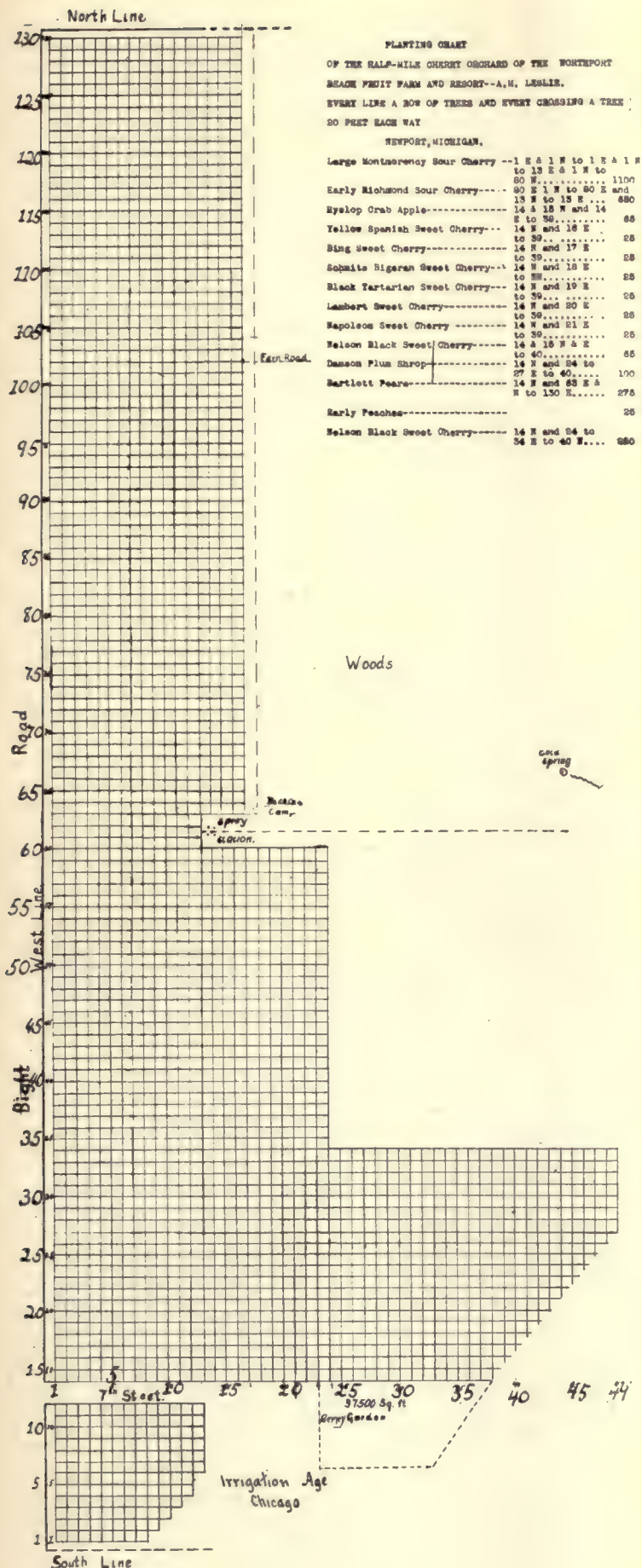
Depth	Area	W. P.	r	\sqrt{r}	C	v	Cfs.	Gals. min.
2'	14.0	11.2	1.25	1.1	57	3.14	43.96	19,727
4'	40.0	18.4	2.17	1.5	67	5.02	200.80	90,059
6'	78.0	25.6	3.05	1.75	70	6.12	477.36	214,218
8'	128.0	32.8	3.89	1.97	75	7.48	957.44	429,678

9. Trapezoidal ditch, base 1 ft., slope 2 to 1, grade 1 in 800, $n = .025$, $s = .00125$. (Fig. 103.)

Depth	Area	r	\sqrt{r}	W. P.	C	v	Cfs.	Gals. min.
6'	1.0	.34	.58	3.24	40	.81	.81	363
12'	3.0	.55	.74	5.48	46	1.19	3.57	1,602
18'	6.0	.77	.88	7.72	52	1.60	9.60	4,308
24'	10.0	1.00	1.00	9.96	56	1.96	19.60	8,796
36'	21.0	1.57	1.25	13.44	61	2.67	56.07	25,156
48'	36.0	1.90	1.38	18.92	64	3.08	111.06	49,844
72'	78.0	2.79	1.67	27.88	79	4.09	319.02	143,161
96'	136.0	3.69	1.92	36.84	74	4.97	675.92	303,362
120'	210.0	4.58	2.14	45.80	76	5.69	1194.9	536,571

RENEW YOUR SUBSCRIPTION PROMPTLY.

Do not delay to remit One Dollar for renewal of your subscription to THE IRRIGATION AGE. You cannot get along without it.



After an orchard is planted, much trouble is experienced in locating the kind of trees planted. One cannot depend long upon his memory or tags. The tags will perish and be torn off, and one cannot be sure after they fruit; often a man will buy an old orchard and know very little of the varieties it contains.

The chart is made by drawing lines east and west and north and south, according to the distance the trees are planted; in this case, it is 20 feet. The rows are then numbered every five rows in both directions, and then the record is numbered and is very much like a map of street intersections.

Numbers corresponding to the plat should be painted and fastened to a stake or fence, at the end of the corresponding row, and no trouble will be experienced in finding any one or number of trees within 50 years.

"N" denotes the north and south lines. "E" the east and west lines in the diagram. To locate any tree or number of trees, first ascertain the north and south row, and then where the east and west crosses it. For a group we will illustrate: Large Montmorency—1 No. 1 E east to 13 as a base then N to 87 E.

The year date of planting should be added to all records.

One of the most modest, withal one of the most interesting of the government irrigation projects is the Huntley, in southern Montana. It represents no spectacular engineering features, yet from a sociological standpoint it is one of the most interesting works so far undertaken. The project embraces about 35,000 acres of land, which was divided by the engineers in farms of approximately 40 acres each. This was a daring thing to do in a country where men believed themselves entitled to as many hundred or thousand acres as they could fence in. The engineers argued that in a region so favorably situated in regard to soil, climate and crops, 40 acres were enough, and the crop report for 1911 has just been received by the Reclamation Service in Washington, and it indicates that their contention was well founded.

During 1911, 12,000 acres were actually irrigated, but crop returns have only been received from 11,100 acres. The estimated value of crops on the area reported was \$316,759, or nearly \$29 per acre. Considering that about 30 per cent of this area was new land cropped for the first time, and that the spring of 1911 was unusually dry and unfavorable for the germination of seed, this is a pretty good showing for amateur irrigators. With only one-third of the acreage of the project in crop, the value of the yield was approximately 37 per cent of the cost of building the irrigation system. The settlers have also acquired live stock of an estimated value of \$224,369, and in addition sold stock during the year, including poultry and poultry and dairy products, amounting to \$32,509.75. Including these sales, returns during 1911 amounted to an average of \$31.46 per acre. A portion of these townsites was offered for sale in August, 1907, and on April 18, 1912, there will be an auction sale of additional lots in four of these towns. This sale offers splendid opportunities for business and professional men and artisans to establish themselves in new towns in the midst of a growing community.

Reclamation Notes

CALIFORNIA.

The Sacramento Valley Irrigation Company is preparing to irrigate several thousand acres of barley in the Maxwell and Delevan units. The company has about 15,000 acres in these units, and while it does not expect to irrigate all of this land, efforts will be made to irrigate as much as possible.

A. Grunauer, Chas. Slack and Ed Sloan, all of Byron, have filed on 25,000 inches of water for irrigation purposes, to be taken from Old River, near Clifton Court. At this point a six-foot tide runs which always insures a plentiful supply of water. According to reports a corporation will be formed and the territory to be reclaimed will be bonded to raise the necessary money for the construction of canals, pumping plant, etc. Part of the land to be reclaimed lies in Contra Costa and Alameda counties, but the bulk is in San Joaquin county.

The Brown-Simmons Company, composed of F. L. Brown of Oakland, C. B. Simmons and G. L. Walker of Portland, Oregon, has filed articles of incorporation with the county clerk. The purposes of the company are to buy and sell land and to construct irrigation systems. The company owns about 13,000 acres of land in the vicinity of Bangor, Palermo and Central House, which it proposes to irrigate.

J. Nahl of Dinuba has begun suit in the superior court against the Alta Irrigation district for \$4,753. Nahl claims that on March 10 the water of the Alta ditch overflowed and damaged his eucalyptus grove to the amount involved.

An assessment of \$20,300 for the improvements needed and the payment of back salaries for employees was voted by the board of directors of the Modesto Irrigation district at a recent meeting. The board also set May 29 as the date of the recall elections against Covall, Trask and Gilman, directors of the district.

Suit to obtain possession of the entire shore line of Clear Lake has been filed against 205 property owners of Lakeport by the Yolo Water and Power Company. The company proposes raising the lake ten feet above the low water mark in order to irrigate 200,000 acres of Yolo county land and to generate electricity for public consumption. Clear Lake covers eighty square miles and is 1,300 feet above sea level.

Trustees of District No. 70, embracing about 20,000 acres of fertile land, lying near Meridian, are panning to raise \$176,000 to complete additional reclamation work. The supplemental plan of reclamation covers the work of increasing the size of the Butte slough and Sacramento River levees and the excavation of the Butte slough by-pass and the acquiring of rights of way for the above purposes.

The canals and tunnel of the Oakdale irrigation system are being finished in record-breaking time, one tunnel being driven 1,145 feet in twenty-nine work days.

COLORADO.

An irrigation committee has been appointed by the Denver Chamber of Commerce to look into all irrigation projects in the state and to prosecute irrigation fake projects. It is the opinion of the chamber that many good projects have been kept out of Colorado for the last five years because the promoters could not raise the money for them, and they lay the blame to the "wild cat" schemes on which eastern capitalists have lost money.

The Ignacio Irrigation district, near Durango, has been placed with the Colorado Land and Water Supply Company under a contract providing that no entryman may be accepted until water is actually on the land. L. M. Sutton, president of the company, has agreed to this new feature in

Carey Act projects and will sign the contract in the near future. The Ignacio district includes 10,000 acres. The new company will give a \$20,000 bond to guarantee the contract.

The Wilcox Canal, which will supply water to 10,000 acres of land between Rifle and Grand Junction, has been completed and water turned into it. The canal is eight miles long, and is a combination gravity and power system. The ditch will take its water from the Grand river at Rifle and carry it twenty-nine miles to the land to be irrigated.

New York, Chicago and Denver capitalists are said to have each put up \$400,000 with which to complete the Greeley-Poudre Irrigation district, embracing 125,000 acres in northern Weld county. D. A. Camfield of Denver and Chicago is heavily interested in the project, as is also W. G. Evans of Denver.

IDAHO.

Fred Lee, a representative of the Fairbanks Morse Company of Spokane, Washington, will reclaim 250 acres of land below Lewiston, this year. Mr. Lee will install a pumping system and will plant his entire acreage to alfalfa.

Plans for the creation of another extensive irrigated region embracing Twin Falls and Owyhee counties have been announced by I. B. Perrine of Twin Falls and W. D. Brown of Rexburg. The new project, which will embrace at least 600,000 acres of land, will cost approximately \$22,000,000. In a general way the plans for the project include the construction of a dam across Snake River at American Falls, impounding the waters in a natural reservoir of about 65,000 acres in area. The new project is called the Bruneau Extension, and with its completion the Twin Falls project will include a total of 1,060,000 acres of irrigated land. To convey the stored water onto the 600,000 acres a concrete lined canal 140 miles long will be built from the town of Cephas to the Bruneau river.

Work is progressing rapidly on the irrigation canal on the west side of Salmon river in the Challis valley. Water which will reclaim a large tract of farming land will be taken from Challis river.

The Crane Falls Power and Irrigation Company of Boise have placed an order with the Westinghouse Electric and Mfg. Company of East Pittsburgh, Pa., for three electric motors, aggregating 5,645 horse-power. The Crane Falls Company is building a project which will reclaim a large area known as the Gem tract. Water for irrigation is being taken from the Snake river. The pumping station, located at Crane Falls, will be completed early in 1913.

The Secretary of the Interior has authorized the Reclamation Service to make a conditional sale to the village of Burley, on the Minidoka Irrigation project, of the necessary poles and wires for a transmission line from the present distributing point on the Minidoka project to the site of the proposed sugar beet factory. The sale is to become absolute upon payment by the village to the United States of the value of the materials. Should the village fail to fulfill the conditions of the sale, the property reverts to the United States and will be used by it in the delivery of the power to the owners of the factory.

NEW MEXICO.

A. T. Coffin is having an irrigation outfit installed on his ranch three miles south of Hondale.

D. J. McCanne, formerly chief engineer with the Fort Sumner Irrigation project, is endeavoring to persuade Roswell capitalists to finance an irrigation project near Fort Sumner. This was formerly known as the Urton Lake project and was abandoned by the government and the land turned over to the state. The state is now segregating 195,000 acres under the Carey Act, and Mr. McCanne is reported to have said that his company will take up 150,000 acres. The land which will be open to entry on May 29 will be sold at 50 cents per acre, and the purchaser must also pay for the water right. It is stated that it will take about \$3,000,000 to finance the project.

Carpenter Brothers, who own a ranch 17 miles south of Deming have installed an irrigation outfit, consisting of a 20 horse-power engine and a No. 5 pump. They will irrigate about 50 acres of land this season.

L. E. Herndon of Albuquerque has installed a 50 horse-power engine and will have 160 acres of land under irrigation this season.

OREGON.

The Mount Jefferson Power Company of Salem has filed articles of incorporation, with a capital stock of \$5,000. The purposes of the company is to create water and electrical power and to promote irrigation projects. The stockholders of the company are R. H. Rutherford, M. J. Lunway and Homer Rutherford, all of Salem.

The Northwest Townsite Company of Philadelphia, Pa., is about to commence work on an irrigation project in central Oregon which will reclaim about 12,000 acres of land. The land lies adjoining the town of Paisley. Water for irrigation purposes will be taken from the Chewaucan River.

The Central Oregon Irrigation Company has filed its trustee contract with the State Desert Land Board, naming the Title & Trust Company of Portland as trustee. The company's canal will cost \$150,000 and, under the terms of the contract, the company is to turn over to the trustee \$15,000 each month to be used in the construction of the canal. The board will, also, upon the filing of a bond by the company, turn over to it all assets and notes now in its possession.

The main canal of the Grande Rode Valley Irrigation Company's project is now well under way. When the canal is completed it will be ten miles in length and will be used to irrigate several thousand acres of semi-arid land between La Grande and Cove. Water is to be taken from the Grande Ronde river. The principal office of the company is located at La Grande.

TEXAS.

McCarthy Bros. of Minneapolis, Minn., and associates, will construct a system of irrigation near Alice, which will irrigate approximately 20,000 acres of land. Water will be taken from San Diego creek.

W. C. Linden of San Antonio, representing a syndicate of English financiers, is promoting the construction of an irrigation project near Alice. It is planned to construct a dam across the Llano river and store a supply of water to irrigate more than 100,000 acres of valley land.

The charter of the Santo Domingo Land and Irrigation Company of Garcias, Starr county, has been filed in the state department. The capital stock of the company is named as \$25,000, divided into 2,500 shares of \$100 each. The company has a large ranch in Starr county which it proposes to irrigate. The incorporators are D. D. Jones and Knox Jones of Garcia, and J. O. Simmons of Morella, Michoacan, Mexico.

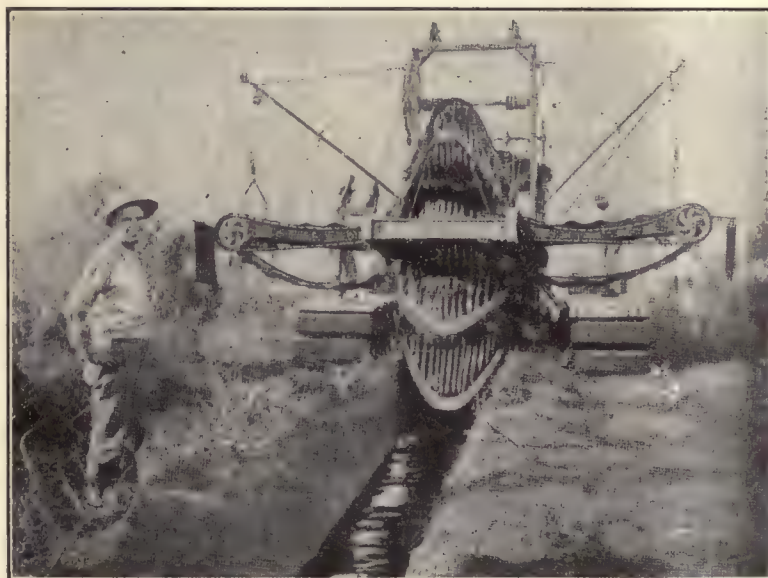
Kansas City capitalists have purchased the Fort Stockton Irrigated Land Company's holdings near Fort Stockton, consisting of 40,000 acres of land for a consideration of \$125,000.

The Moore-Cortes Canal Company has sold its pumping plant, canals and warehouses, lying adjacent to the town of Markham, to the Markham Irrigation Company, and have made a sales contract covering their 16,000 acres of land watered by the canals with other parties who are now subdividing the tract and getting same ready to place on the market. The Markham Irrigation Company will make several miles of extension to the main canals for the purpose of reaching several thousand acres of sod land, part of which will be watered this season.

UTAH.

The Clearfield Irrigation Company of Clearfield has filed articles of incorporation; capital stock, \$10,000, divided into 10,000 shares of \$1.00 each.

BUCKEYE TRACTION DITCHERS REVOLUTIONIZE RECLAMATION WORK IN THE SOUTH



SINCE the "BUCKEYE" has been used in reclamation projects throughout the South, thousands of acres of waste land have been reclaimed and utilized for colonization purposes.

Before the "BUCKEYE" became an important factor in reclamation projects, the cost and hard work entailed in drainage and irrigation impeded the colonization of marshy land.

The "BUCKEYE" was the first machine made that could be operated on soft, land. The apron tractions carry the ditcher over wet ground that will not sustain the weight of a team of horses and an empty wagon.

It is also the first machine made that will cut a ditch with a sloping bank at a continuous cut. Ditches of from 2½ to 12 foot top can be cut with the "BUCKEYE", according to the size of machine used. Every ditch is of uniform size and perfect to grade.

The "BUCKEYE" takes the place of from 50 to 150 men and does the work better, faster and cheaper, reducing labor bills to almost nothing.

WRITE TODAY FOR CATALOGUE No. 26

This 'explains the BUCKEYE DITCHER and shows you how you can turn your waste land into dollars.

THE BUCKEYE TRACTION DITCHER COMPANY

FINDLAY, OHIO

The Utah Lake Irrigation Company has succeeded in financing their irrigation project and this fall will install their pumps on Utah Lake, about one mile south of the Saratoga Springs. Six miles of their canal has already been completed and the whole system will be ready for supplying water to 5,000 acres of land west of Lehi for the season of 1913. The main canal of the project is ninety-nine feet above compromise point of Utah Lake, which means that the water will have to be pumped to that altitude. The pumped water will cost the farmers \$35 per acre, and the annual maintenance fee will be about \$3.00 per acre more.

The Provo River Reservoir Company's canal will be extended during the present summer to cover all the lands north of Lehi. The canal will supply water to all those who sign up prior to June 1 at a price of \$80 per acre, after which date the price will be advanced to \$90.

Articles of incorporation have been filed by the Sand Point Irrigation Company of Spanish Fork; capitalization, \$30,000, in shares of \$5 each. The entire capital stock is paid up in taking over an improved application for 30 cubic feet of water per second from Utah Lake.

The New Hope Irrigation district has obtained \$20,000 from the state board of land commissioners, which money is to be used in completing the ditch. The cost of the ditch up to the present time is \$20,000. This ditch, when completed, will water about 4,000 acres of land in the eastern part of the state, and the homesteader will be able to secure the water at a low cost—about \$10 per acre.

The Grand Valley reclamation project has been abandoned by the government and, according to an order received at the United States land office in Salt Lake, the land embraced therein will be thrown open to entry on July 5 of this year. The land was withdrawn by the government about two years ago and was made an extension of the government project near Grand Junction. The land is located in Grand county, between Cisco and Westwaster, and is considered valuable land. The order received at the Utah land

office states that squatter's rights may be exercised on and after June 5, 1912, and that any person who exercises these rights may have a preference of entry on July 5, 1912.

Articles of incorporation have been filed by the Newcastle Irrigation Company; capital stock, \$1,000,000, in 20,000 shares at \$50 per share, par value. Water for irrigation purposes will be taken from Grass Valley and Pinto creeks to reclaim many thousands of acres of desert land in Iron county, and in the vicinity of Newcastle, where the principal offices of the company are located. J. A. Eldridge, president; N. T. Porter, secretary and treasurer, and Dr. Middleton, vice-president, all of Salt Lake City, and J. L. Sevy, of Panguitch, are the incorporators. The land is located on an elevated slope, has a depth of soil ranging from 15 to 200 feet, with an elevation of 5,000 feet, and lies north-east of the Dixie national forest reservation.

WASHINGTON.

Construction of the irrigation system which is to water the 90-acre "Smith Place Irrigation" tracts, four miles south of Walla Walla, has been begun under the direction of Freuler & Dyen, engineers. The tract is owned by a syndicate of Walla Walla men and comprises rich land watered by an artesian well. The land has been divided into five-acre lots and a pipe line that will carry water to each tract is now being laid. A concrete-lined reservoir will be built on the highest point of land and will have a capacity of 175,000 gallons. In distributing the water for irrigation, the pumps will be shut off and the water will flow back through the same pipe by which it was pumped into the reservoir.

The Cascade Irrigation and Power Company of Tacoma has filed articles of incorporation with a capital stock of \$20,000.

Fred C. Hamilton and Von K. Wagner of Spokane have organized a company under the name of the Keystone Security Company, which proposes to irrigate a tract of land which they own in the vicinity of Moses Lake. Offices of

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Fruit, Truck or Dairy Ranch*

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Newcomer's Home on the Bartlett-Heard Ranch

The Most Attractive Homemaking Inducements

offered in this beautiful valley are found on the

BARTLETT-HEARD RANCH

Small tracts of fertile land, now in cultivation, may be secured on the most favorable terms. 2,000 acres of the "B-H" Ranch have been sold already, and over 40 new homes were built there last year. Twenty acres is the size of the average tract sold. Of these lands, under the old San Francisco canal, located 2½ to 6 miles from Phoenix, there now remains unsold less than 2,500 acres. Indications are that the major portion will be sold this year. **WRITE TO-DAY FOR A MAP AND PRICES.**

BARTLETT-HEARD LAND AND CATTLE CO.
PHOENIX, ARIZONA

When writing please mention The Irrigation Age



The Kind of Land We Are Selling

the company, which is capitalized at \$100,000, have been established at Spokane.

Officials of the United States Land Office in North Yakima have received advices from authorities in Washington to accept maintenance charges for the present irrigation season from water users under both the Sunnyside and Tieton projects who are delinquent in both building and maintenance charges for past seasons. Water will be allowed them this year as soon as the back maintenance charges and those for this season are paid.

Seventeen hundred acres of orchard lands, a short distance north of the city limits of Spokane, will be developed the coming summer by Jay P. Graves, Clyde M. Graves and Aubrey Lee White. Drill tests show the entire district is underlaid by a large flow of water at depths of from 60 to 80 feet, making the problem of irrigation a simple one. Wells have been driven and will be operated by electricity to obtain water for irrigation. The distribution will be by means of concrete pipes laid under the ground.

Land owners under the Outlook, Snipes Mountain, Grandview and Mabton pumping plants of the Sunnyside canal, in central Washington, have voted to accept the propositions submitted by Frederick H. Newell, director of the Reclamation Service, relative to the construction of the works. The four plans will provide water for 15,000 acres additional. Assurance has been received that the work will be started immediately upon the signing of contracts by the land owners and their approval by Secretary of the Interior Fisher. It is expected that the pumping plants will be installed and laterals built in ample time to have water available by the spring of 1913. The plant cost is about \$30 an acre, the water charge being \$52 an acre.

Engineers are collecting data to ascertain the cost of reclaiming more than 30,000 acres of land in the Brewster district or Okanogan county, northwest of Spokane, where a bond issue of \$1,250,000 for the district was carried by a vote of 107 for and 6 against at a special election on April 2.

These directors, who will have charge of the work, were re-elected: Roy Dorothy, W. M. Allen and T. M. Elliott, all of Brewster. In this way the growers will control the affairs of the irrigated district, own the water and hold their land intact. The lands, which extend north from the town of Brewster several miles, and reaching back from the Columbia and Okanogan rivers toward the foothills, present extremely favorable conditions for development under irrigation. With other areas lying contiguous to the Okanogan, Columbia and Methow rivers, they combine to make a total of 35,000 acres.

The Brewster flats proper, about 15,000 acres, formerly were a part of the state's school land, the bulk of them having passed into private ownership within the last four years. They consist of comparatively level bunch-grass benches, paralleling the Columbia river at elevations varying from a few feet to 500 feet above the water level. A plan was formulated several years ago for reclaiming the entire district, but was not carried out. It was purposed to construct a diversion weir in the Methow near the town of Twisp, where a supply of water is available sufficient to reach every part of the ditch with a gravity flow. More than 2,000 acres is under irrigation and a large portion is in orchards. The soil is a sandy loam, liberally mixed with the volcanic ash characteristic of the region. A strata of gravel generally underlies the top soil at a depth ranging from two feet to eight feet, affording excellent drainage.

MISCELLANEOUS.

The state engineer of South Dakota has granted permits for irrigation for 216 acres to Ray D. Walker of Fort Pierre from the Cheyenne river; for 112 acres from Bad river to Ada Dinsmore of Fort Pierre; and for 239 acres from the same stream to Millett and Sumner of Fort Pierre.

The Cy ranch, located two miles southwest of Casper, Wyoming, owned by Gov. Carey, is to be partially irrigated by the use of a pumping station. A 12-inch centrifugal pump will be installed which will pump water to irrigate approximately 400 acres.

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ARIZONA



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The Twentieth Century Ditching Machine

stands without an equal. It will make a mile of ditch 24 inches deep in one day. Is easily operated by one man and can be used with two or four horses as desired. Weighs less than half as much as the heavy grader and does better work at one-half the expense. It will pay every owner of land to learn all about this many purpose irrigation machine. It will not only cut drainage ditches, but levels land, cut laterals, sage brush, throws up dikes, etc.

Write for booklet showing photo reproductions of machine in action, and explaining great money and labor-saving features.

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Write us, or far better, come to Glendale.

BOARD OF TRADE

GLENDALE, ARIZONA

The Tepic Agricultural Company, composed of Americans, is making arrangements to construct a system of irrigation to reclaim 50,000 acres of land lying near to the City of Mexico. Under the terms of the concession granted the company by the Mexican government, it is allowed to import the machinery and material necessary for the works free of duty.

The Secretary of the Interior has authorized the Reclamation Service to lease all the available water on the Milk River Irrigation project in Montana for the season of 1912. Water is to be furnished at \$1.00 per acre-foot, one-half of which amount must be paid in advance.

The building of a 1,000-foot siphon, 100 feet under the Colorado river, from California to Yuma, has been accomplished. The opening of the siphon will open 100,000 acres of the Yuma irrigation project. Water will be turned into the canal late this month and a formal celebration will probably be held on June 17. The building of this siphon is one of the greatest and most dangerous pieces of engineering work ever undertaken by the Reclamation Service.

Sixty-three hundred acres of land under the Shoshone Irrigation project in Wyoming were opened to homestead entry on April 22. The first unit of the project was supplied with water four years ago and the land that was opened on the 22nd constitutes the fourth unit of the project. From time to time other units will be added until the entire area of the project, 164,000 acres, will be brought under irrigation.

An immense irrigation project, by which it is expected that no less than 250,000 acres will be reclaimed, is about to be undertaken in Montana. This is the so-called Milk River project, which will cost approximately \$7,000,000. The project involves the storage of water in the two St. Marys lakes in the northwestern corner of the state, and the diversion of the storage water from the St. Marys drainage basin—which now discharges eventually into the Hudson Bay—into the Milk River drainage basin by a canal 29 miles long.

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Salt River Valley

All land irrigated from the Great
Roosevelt Dam

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sale on EASY TERMS

Southwestern Sugar and Land Co.
GLENDALE, ARIZONA

Articles of incorporation have been filed with the secretary of state of Montana for the Pleasant View Power and Irrigation Company. The company is capitalized at \$100,000; incorporators are Kate H. McCormick, W. J. McCormick, John McCormick, T. McCormick and Honora McCormick Houghton, all of Missoula. The company will build a dam across Bear Creek in Missoula county to divert the waters of the creek for irrigation purposes. They will also build a power plant to generate electricity.

The Secretary of the Interior has announced that 10,677 acres of the Belle Fourche (South Dakota) irrigation project will be opened for entry by homesteaders on May 25.

The Secretary of the Interior has authorized the Reclamation Service to furnish water to such gravity lands below Yuma, Arizona, as may be reached by the government lateral systems for the Yuma project, as this is completed. The charge for such service shall be at the rate of 50 cents per acre-foot of water delivered at the turnout of the Government lateral.

A movement has been inaugurated by J. J. Harris and E. G. Logan, Edward Lawlor and A. Becker, all of Hardin, Montana, to develop the Big Horn Canyon Irrigation project. The project has long been known as feasible and was first investigated by the Government twenty years ago, and a supplemental survey was made by the Reclamation Service eight years ago, but the project was abandoned in favor of the Huntley project, because of the less cost of the latter. The promoters are reticent as to the source of their financial backing, but claim that they have ample capital to develop the project in the event the Government will give them the right to proceed with the work. It is estimated that the project will cost approximately \$7,000,000.

The Fergus County Land & Irrigation Company of Butte, Montana, will resume work in the near future on its big irrigation project in the Flatwillow section. About \$25,000 will be expended this season and the company will

Mr. "Big Scale" Farmer and Mr. Cattle Raiser, Here Is Something "Big" for You

We are offering the Meredith Ranch for sale. This ranch consists of 8400 acres, in Carbon County, Wyoming, close to Union Pacific R. R. town and in the pathway of the survey for the extension of the Denver, Laramie & Northern Railroad.

4,000 acres are under perfect water rights, and the State Engineer has issued a permit for the construction of an additional ditch which when completed will irrigate 6,000 acres. Ditches and laterals are finished and a number of living streams furnish water the year around.

The ranch is highly improved, it has a large stone residence, 3 other dwelling houses; several large barns; corrals, hay barn, sheds, dipping vats, blacksmith shop, store houses, 80 miles of fence and other sundry improvements, and included in the sale are \$2,500 worth of farming machinery, vehicles, rakes, stackers and tools of all kinds.

The Government has issued a license permitting the owner of the Meredith ranch to graze live stock in the Medicine Bow National Forest Reserve which lies immediately south of the ranch.

75% of the tract is level or gently rolling; balance is first class grazing land. Besides producing 1,500 tons of excellent hay the ranch produces grain, such as wheat, oats and barley, and 5,000 tons of hay could easily be cut yearly.

Arrangements can be made to purchase the cattle and sheep of the present owner.

**THE PRICE IS \$15 AN ACRE
ON EASY TERMS**

With 6% on deferred payments.

Title Guaranteed Perfect.

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Delta County

was awarded the Guggenheim Cup for the best display of perfect fruit in competition with the United States at

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- ¶ At the National Horticultural Congress in Council Bluffs, Iowa, it received 36 awards of 42 entries.
- ¶ The result of fruit growing in Delta County has been one of continued and uninterrupted success.
- ¶ The intelligent farmer and investor knows that irrigated lands are the best and safest investment in the world. In Delta County he can obtain the best land, the best water rights, in a section in which the towns of Delta, Hotchkiss, Cedaredge, Paonia and Austin are not only home markets but also convenient railroad shipping points. Delta County is not only the banner fruit county of Colorado but yields immense crops of wheat, oats, grain, alfalfa and is an excellent poultry, dairy and live stock section.
- ¶ We can sell you some of the best farming land with perfect water rights at \$150 an acre—Write for further information and illustrated booklet.

Tell us what you want—we have it.

The Sam Farmer Escalante Irrigation Company

Branch Office, Delta, Colo.

1721 Stout Street, DENVER, COLORADO

have the project completed this year so that 20,000 acres of land will receive water for irrigation next season. The company has 8,000 acres of land withdrawn under the Carey Act and can irrigate 12,000 acres under private ownership. The water supply is taken from Flatwillow Creek and is ample to thoroughly take care of the 20,000 acres.

The Hidalgo Land and Irrigation Company has filed articles of incorporation with the secretary of state; capital stock, \$750,000; principal office located at Phoenix, Arizona.

The Ambursen Hydraulic Construction Company of Montreal, Canada, has been awarded the contract for building a municipal plant on the North Saskatchewan River for the City of Prince Albert, Saskatchewan. The dam is 36 feet high and 755 feet long over all, it being a part of a navigation system. The dam contains a lock 40 feet by 250 feet in the clear. 15,000 horse-power will be ultimately developed.

The Reclamation Service has contracted with the Bucyrus Company of South Milwaukee, Wisconsin, for furnishing an electric shovel, 66-ton weight, for use in connection

\$5.00

Genuine Navajo Blankets

My business is done directly with the Navajo Indians, whose reservation is near Aztec. I make trips to the reservation and purchase the best in the line of Navajo rugs and blankets direct from the Indian weaver. I have no middleman to pay. Why pay \$20 to \$30 for a Navajo rug or blanket in a Chicago store when I can sell you the finest quality from \$5 to \$35, depending on size. If not satisfied after examination I will refund your money, and I refer to the Citizens Bank of Aztec as to my responsibility. Before buying a Navajo rug or blanket write me telling me size you want and get my prices.

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Aztec, New Mexico

A. W. SLOSS,
Manager

R. H. CASE, Consulting
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Guaranteed land script in section blocks \$7.00 per acre, used in connection with relinquishments in the Mimbres Valley enables us to deliver patented land in blocks for \$15.00 per acre. Improved tracts with independent water rights \$150 per acre. Relinquishments \$5 to \$15 per acre, depending upon location. Patented land, unimproved, \$20 to \$75 per acre. *Reports on the Mimbres Valley furnished on application.*

SLOSS-CASE LAND CO.

DEMING

NEW MEXICO

Irrigators, Attention!

WE have a district of independent water-rights. No weeds from a community ditch, no waiting your turn for water, no chance for water-thieves to steal your water. On the other hand, our farmers have water whenever they want it. It is the purest water in America. The original water-right costs but \$20 or \$30 per acre, and is based on the most dependable supply of water for irrigation on the globe—namely, on the great underflow of the Mimbres Valley, which has a watershed of 1,400 square miles and a pumping area of only 125,000 acres at the most. The lift for water varies from 15 to 100 feet, and with improved devices for raising water, every well-informed man knows that where abundant water can be secured at such a lift, the pumping plant makes the surest, cheapest and most dependable water-right in the world. We have it here. Also low values. It is just the sunniest and most beautiful valley in New Mexico, and just the place to build a cozy country home that will make you and your family independent for all time to come. Now is the time to get in on the ground floor. Less than five per cent of the irrigable area is reclaimed. This, of course, means rock-bottom prices. Write Secretary, Deming Chamber of Commerce, Deming, N. M., for a booklet describing the best irrigation proposition in America. Don't wait. Write now.

Please mention name of this publication.

with the construction of Lahontan dam, Truckee-Carson Irrigation project, Nevada. The price to be paid is \$12,050 f. o. b. cars South Milwaukee.

The Secretary of the Interior has authorized the Reclamation Service to arrange for the construction of dams to create two storage reservoirs in connection with the North Platte Irrigation project, Nebraska-Wyoming. The general plan for the development of the canal system includes the construction of three supplemental storage reservoirs along the Interstate Canal about nine miles northeast of Scottsbluff, Nebraska, known as reservoirs 1, 2 and 3. They are to receive their water from the main canal and are to feed lateral systems covering about 46,000 acres. Work on the project has now advanced to the point where it is necessary to construct the dams for reservoirs 1 and 3.

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The "Primer of Hydraulics" is the only book teaching Hydraulics in a practical way. Price \$2.50, cloth bound. THE IRRIGATION AGE, Chicago.

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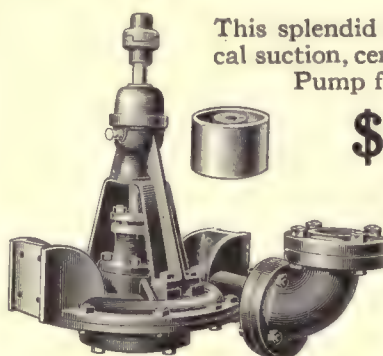
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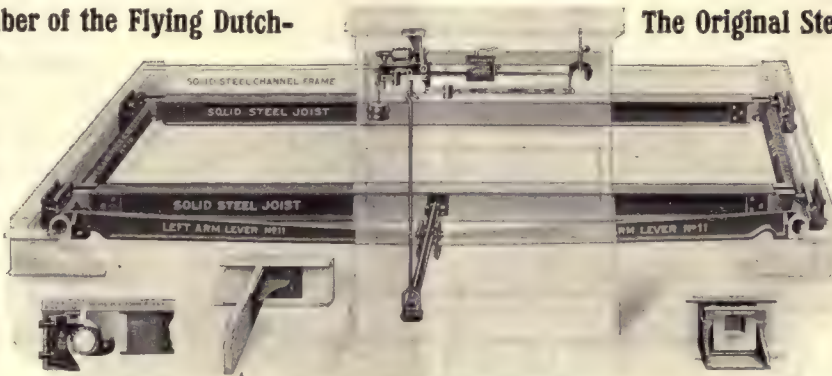
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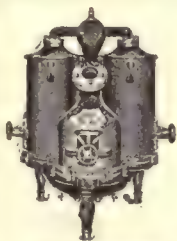
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Saves fifty per cent of fuel.

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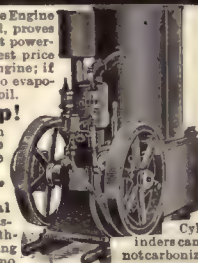
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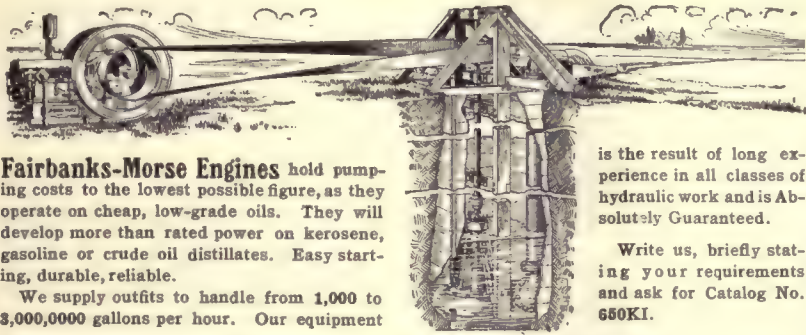


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GOODHUE WINDMILLS

You can dig 40 foot Wells quickly through any Soil with our Outfit at \$12 Delivered

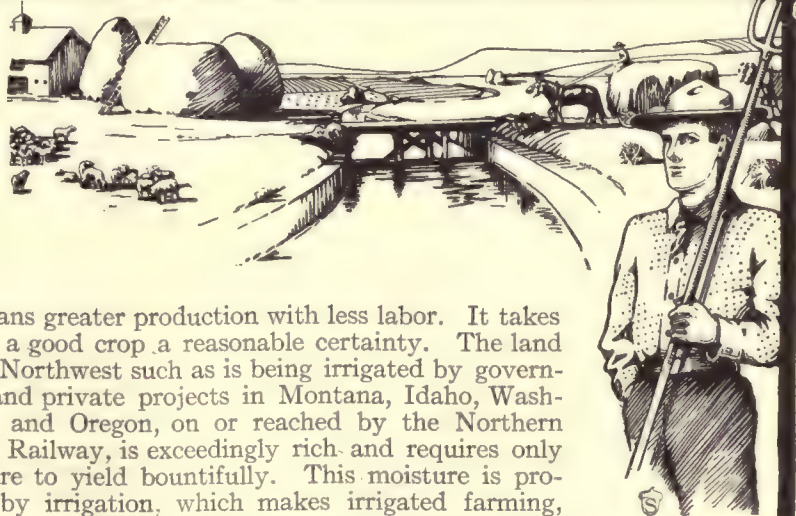


No. 1 Outfit—Bores 40 ft., \$12 Delivered
No. 2 Outfit—Bores 100 ft., \$25 Delivered
WE POSITIVELY GUARANTEE these outfits will bore in hardpan, sand, grit, gravel, sticky clay, mud, gumbo, or anything else, excepting SOLID ROCK. If it fails to do the work—just as we say, your money back quick. Write today.

Standard Earth Auger Co.
1251 Newport Avenue, Chicago, Ill.

Send \$1.00 for The Irrigation Age, one year and the Primer of Irrigation, Paper Bound.

Irrigated Farm and Fruit Lands



The small irrigated farm or orchard means greater production with less labor. It takes away the element of chance and makes a good crop a reasonable certainty. The land in the Northwest such as is being irrigated by government and private projects in Montana, Idaho, Washington and Oregon, on or reached by the Northern Pacific Railway, is exceedingly rich and requires only moisture to yield bountifully. This moisture is provided by irrigation, which makes irrigated farming, fruit and vegetable raising a scientific profession, not a drudgery. The ideal climate is a strong argument in favor of the Northwest.

The Northern Pacific extends into or through Minnesota, Wisconsin, North Dakota, Montana, Idaho, Washington, Oregon. New, rich territory being opened up by extensions now building. The Homeseeker's Chance!

If you want to know more about the possibilities of making your efforts bring you greater returns, write for information about these irrigated lands. Maybe the "dry farming" territory will interest you. Write tonight and state what section you are most interested in. Don't delay. The information will cost you nothing and will pay you well.

*The Scenic Highway Through the Land of Fortune

Northern Pacific Railway

L. J. Bricker, General Immigration Agent, 53 N. P. Bldg., St. Paul, Minn.

A. M. CLELAND, General Passenger Agent, ST. PAUL



E 2

CLASSIFIED ADVERTISEMENTS

GET A HOME IN NEW MEXICO, THE NEW STATE, where land is cheap and life worth living. Ideal climate. We sell no lands. Write today for book "T" with map. It's free.

State Immigration Board,
Albuquerque, N. M.

COLORADO FARM BARGAIN, 160 ACRES choice land, fenced, house and outbuildings, dandy well, pure water, at 25 feet; near school and town; fine proposition for practical farmer. Only \$3,200. \$750 cash, balance to suit, 6%. F. E. Hammond, 321 Colorado Building, Denver, Colorado.

900 ACRES, NEAR DEL NORTE, 2 SETS improvements, fenced, cross fenced; all cultivated; paid up old water right. \$75 an acre, terms. Cole & Snyder, 1650 Champa Street, Denver, Colorado.

80,000 ACRES, NEW MEXICO; 20,000 SUBJECT to irrigation; 10,000 underlaid with coal; excellent colonization proposition. For reports, information, write Sutton, 203 Symes Building, Denver, Colorado.

ADJOINING BEST TOWN IN NORTH- eastern Colorado, a 665-acre irrigated tract, 600 acres in hay, cutting 1,000 tons yearly. Free water rights. Best section Platte Valley on Union Pacific Railroad. Owner will accept one-third cash, balance in one-half of hay crop for first five years. Price \$90 per acre. For further particulars, Globe Investment Company, 484 17th St., Denver, Colorado.

REAL ESTATE, IMPROVED IRRIGATED Farms. We offer a splendid opportunity for the investor and for the home seeker. Land bought now at Antonito will make a better living for the farmer and show a larger increase in value for the investor than any place in the world. We can sell you improved irrigated farms with the best water rights for \$60 to \$60 that will produce crops that will pay the purchase price in two years. A card addressed to the undersigned will bring you all the information you desire regarding this wonderful opportunity. W. D. Carroll, Antonito, Colorado.

IRRIGATED LANDS IN THE PECOS valley, Texas. 25,000 acres of richest fruit and alfalfa land in country. Six cuttings of alfalfa yearly, averaging over ten per acre each cutting. Every known crop grown. The Orient Railroad, builder of irrigating system, runs to tract direct and connects with three other roads, affording direct lines to markets and Gulf ports. Ideal climate. Elevation 2,400 feet. Over one-half tract sold, 7,000 acres being cultivated. Detailed information, Wray and Trimmer, 410 Ideal Building, Denver, Colorado.

AGENTS WANTED—OIL AND GAS IN San Luis Valley, Colorado. Best selling \$10.00 proposition on the market, in payments of \$3.00 cash, \$3.00 in 30 days, \$4.00 in 60 days. No interest. No stock. Attractive commissions. Active salesmen can make \$50.00 to \$75.00 per week. For further particulars write at once to San Isabel Oil and Gas Co., Moffat, Colorado.

DO YOU WANT INFORMATION? OUR business is giving information. Any subject, any place. We buy any article for you, tell you where to buy it. Anything you wish to know ask us. The National Information and Buyer's Agency, 1426 E. 22d Avenue, Denver, Colorado.

A WELD COUNTY BARGAIN—I AM THE owner of a 320-acre tract, near the growing town of Ault, on the Union Pacific Railroad, with Cheyenne, Greeley and Denver convenient market places. Excellent grain land. Will sell for \$12.50 an acre. \$1,000 cash, balance in 8 annual payments at 6% interest. Investigation invited. One of the best and cheapest "buys" in northern Colorado. J. I. Carper, Chamber of Commerce Bldg., Denver, Colorado.

WE HAVE 20,000 ACRES OF GOOD ranch land in New Mexico, that we are dividing into ranches of from 640 acres up. Running water on most of the tracts with some timber and abundance of grass. This land will be divided so that there will be valleys on all of the tracts susceptible to irrigation which will produce all kinds of grain, fruit and 5 tons to the acre of alfalfa. The winters are mild and you do not have to feed. Parties wishing to raise mules, horses, sheep and cattle should make big money on their investment. The price ranges from \$7.50 to \$15.00 per acre, according to size and location. We also have 15,000 acres of irrigable land. Price \$50.00 to \$100.00 per acre. Write us at once. The Rayado Colonization Company, 1646 Tremont Street, Denver, Colorado.

60,000 ACRES IN ONE BODY IN Archuleta county. Finest stock ranch for horses, sheep or mules. Stumpage value alone \$60,000. Fine water power and irrigation possibilities, also petroleum. Price, \$3.00 per acre. E. W. Merritt, 708 17th street, Denver.

FOR INFORMATION REGARDING IRRIGATED lands in the vicinity of Saguache. Fine lands at \$10 to \$100 an acre. Only set of abstract books in county. All inquiries cheerfully answered. The Saguache County Abstract and Improvement Co., W. M. Slane, Mgr., Saguache, Colo.

IN THE GARDEN OF EDEN, OTHER- wise called Montezuma county, near Dolores, 120 acres finest soil known; raises everything. 10 acres in 4-year-old apples, raised forty bushels of wheat to acre last year, finest hay and sugar beet land. 12 foot vein bituminous coal under entire ranch. Price, \$6,500. Wonderful bargain. E. W. Merritt, 708 17th Street, Denver.

FOR SALE AT A SACRIFICE 320 ACRES near Alamosa, San Luis Valley, Colorado. 320 acre relinquishment near Rocky Ford coming under irrigation, \$1,000. We have all kinds of ranch and farm and city property to exchange. Tell us what you have and we will get what you want. If you are coming west, write us, we have some fine irrigated land and large ranches to trade for eastern property.

L. J. MOUNTZ & CO.,
Real Estate and Mining Investments,
1743 Champa Street, Denver, Colo.

FOR LANDS IN THE SAN LUIS VALLEY with best water rights at prices from \$30 to \$100 per acre; see me. I have farmed 14 years and sell only good farming land. J. C. Milyard, Alamosa, Colorado.

I HAVE SOLD LAND AT MOSCA FOR 4 years. I am a practical farmer. Have 1,600 acres which I own and will sell for \$30 to \$75 an acre. All cultivated. Good water right. W. W. Saunders, Mosca, Colorado.

IRRIGATED LANDS IN THE LA JARA District, \$50 to \$60 per acre. I specialize in farm loans, insurance and have San Luis Valley irrigated lands for sale at all times. C. L. Smith, La Jara, Colo.

LA JARA'S LAND FIRM—NO TROUBLE to answer inquiries. An active land firm in La Jara that gives its patrons a square deal and refers to the La Jara State Bank as to its financial responsibility. Good land, perfect water rights, reasonable terms. Write for illustrated folder. Seeley & Dougan, La Jara, Colorado.

FINE RANCH AT DEL NORTE IN SAN Luis Valley. Close to city, Rio Grande river flows through. Fine buildings and timber, splendid stock ranch. Plenty of hay. Price, \$12,000 for 240 acres. E. W. Merritt, 708 17th street, Denver.

IDEAL STOCK RANCH IN THE FAMOUS San Luis Valley, Colorado. 1,440 acre stock ranch near Center; 6-room house, barn, corals; 10 artesian wells. Sacrifice, \$35 an acre, one-third down, balance easy. 100 choice cows and 50 head horses. Choice San Luis Valley lands \$40 an acre. J. W. Hess, Mayor of Center, Center, Colorado.

HOME AND INVESTMENT LANDS, LA Jara district. Choice irrigated lands improved, unimproved, \$45 to \$85 acre. Wilson & Rucker, La Jara, Colorado.

I AM READY TO BUY ANY TRACT OF good land in the San Luis Valley for cash. I buy for cash and can sell at lowest prices. Walter N. Ickes, Alamosa, Colorado.

FOR SALE

160 acres fine land in famous Yellowstone Valley, E. Mont. Near R. R. Very level. Under Gov't Irrigation. Good for grain, Alfalfa, Vegetables, etc. Only \$25 an acre. Will be worth \$50 soon. Owner a non-resident and not a farmer. W. B. OVERSON, Owner, Williston, N. D.

COME TO VIRGINIA

Homes for all, health for all, happiness and independence for all. Ideal climate; no malaria, no mosquitoes. Write for our land bulletin which will interest you.

J. R. Meadows, Appomattox, Va.

Send \$1.00 for The Irrigation Age 1 year, and the Primer of Irrigation

Here's Your Irrigating Engine

Runs on Kerosene, Gasoline or Distillate.

This irrigating engine is low-priced, very simple and absolutely dependable. Nothing complicated to get out of repair; only three moving parts. Fill up the tank and it will run all day without the attention of an operator.

Exceptionally low fuel cost because it uses kerosene, gasoline or distillate without any change in equipment.

Read What These Men Say:

A Seattle irrigator's opinion: "As I am using kerosene, my running expenses are not worth mentioning. My engine runs like an Elgin watch."

Another in California says: "I use distillate and can run the 6 H. P. for 10 hours on 35 cents worth of this fuel."

30 DAYS FREE TRIAL.

You don't have to take our word for it. We'll send this engine to you anywhere in America with freight prepaid. No obligation to buy until satisfied; then an absolutely binding Ten Year Guarantee. Write for new catalog; tell us what your problem is and get full information.

Stationary engines for every purpose.
Special rates on irrigating pumps.

Ellis Engine Co., 241 Antoine St., Detroit, Mich.

When writing to advertisers please mention The Irrigation Age.



WHITMAN'S HAY PRESS

40 Years Standard of the World

New Model Steel Beauty ALL STEEL.

Let us prove that our New Model is the Strongest, Most Durable, Most Economical and Simplest Hay Press in the World—does the best work—has greatest capacity—saves time, labor and trouble—contains exclusive feature found in no other press—with or without self-feed, pull back and hopper condenser—fully guaranteed—we make largest line of Bailers in the world. Write today for big free catalog.

WHITMAN AGRICULTURAL CO., 1862 S. Broadway, St. Louis

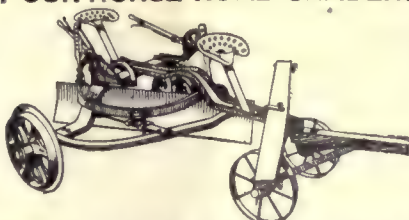
Sandow \$42⁵⁰

2½ H.P. Stationary Engine — Complete

Gives ample power for all farm uses. Only three moving parts—no cams, no gears, no valves—can't get out of order. Perfect governor—ideal cooling system. Uses kerosene (coal oil), gasoline, alcohol, distillate or gas. Sold on 15 days' trial. YOUR MONEY BACK IF YOU ARE NOT SATISFIED.

5-year ironclad guarantee. Sizes 2½ to 30 H. P., at proportionate prices, in stock, ready to ship. Postal brings full particulars free. Write for proposition on first engine in your locality. (180)

Detroit Motor Car Supply Co., 178 Canton Ave. Detroit, Mich.

**FOUR HORSE ROAD GRADERS**

Rural Road Grader and Irrigation Ditcher and Edwards New Reversible Road Grader

Besides Graders I manufacture the best STEEL ROAD DRAGS

Don't buy GRADERS or DRAGS before you get my Prices and Descriptive Catalog.



Clearing land with one of my Stump Pullers. Catalog will come for the asking.

C. D. EDWARDS, ALBERT LEA, MINN.

Soil Salvation

25 years practical experience back of Bostrom's book entitled "Soil Salvation." After studying it, you will know how to make useless land grow as big crops as the best, by DITCHING, TILE DRAINING, TERRACING or IRRIGATING. This book is FREE to interested land owners who write for it—it fully explains the use of

The Bostrom Improved \$15 FARM LEVEL

With Telescope

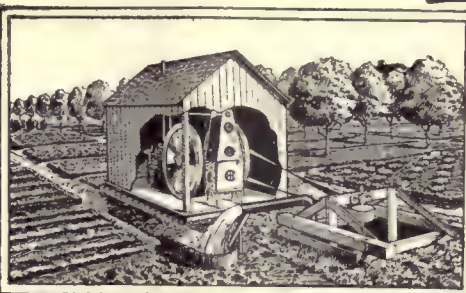
A perfectly SIMPLE, ACCURATE and DURABLE outfit which includes Level, TELESCOPE with magnifying lenses enabling you to read target a quarter of a mile or more away—also Tripod, Graduated Rod, Target, Plumb Bob and full instructions. Is used and indorsed from the Atlantic to the Pacific for all sorts of farm leveling.

If not sold in your town, will ship direct on receipt of price, \$15—or will ship C. O. D., subject to examination. Money back if not satisfied AFTER ACTUAL FIELD TRIAL.

Bostrom-Brady Mfg. Co.
119 Madison Ave., Atlanta, Ga.



Is There Water Near or Under Your Land?



IF so, the best way to raise it and distribute it on your land, where it will provide needed moisture for your crops, is to install a pump of sufficient size, run by a dependable I H C gasoline engine. The added profit on one crop grown with a plentiful water supply instead of uncertain or insufficient rainfall, will often pay for the entire outfit. The essential features of a pumping outfit are dependability, durability, and economy—positive assurance that you can have plenty of water when you need it for many years to come and at the lowest possible cost. The one best way to insure this is to install an

I H C Gasoline Engine

dependable because correctly built, durable because made of the finest material, and economical both to maintain and run. I H C gasoline engines offer a wide range of choice in style and size to the wise buyer—1 to 50-horse power, horizontal and vertical, air-cooled and water-cooled; stationary, portable, and mounted on skids; built to operate on gasoline, kerosene, naphtha, distillate, or alcohol; tractors in three styles, from 12 to 45-horse power. The traction engine is particularly valuable for use on large irrigated tracts. The I H C line includes sawing, grinding, and spraying outfits in various sizes. See the I H C local dealer for catalogues and full information, or write the nearest branch house.

WESTERN BRANCH HOUSES: Denver, Col.; Helena, Mont.; Portland, Ore.; Spokane, Wash.; Salt Lake City, Utah; San Francisco, Cal.

International Harvester Company of America

(Incorporated)

Chicago

U S A

I H C Service Bureau

The purpose of this Bureau is to furnish, free of charge to all, the best information obtainable on better farming. If you have any worthy questions concerning soils, crops, land drainage, irrigation, fertilizer, etc., make your inquiries specific and send them to I H C Service Bureau, Harvester Building, Chicago, U S A



A NEW JOHN DEERE BOOK NOW READY!

Better Farm Implements and How to Use Them

JOHN DEERE PLOW CO.

- Mailed Free To Farmers

Describes and illustrates completely the latest improved farm implements. CONTAINS special articles on the care, adjustment and operation of implements, interesting to progressive farmers.

It is a big book, 9"x11" in size, handsomely printed. There will be a great demand for this new big book, so write at once.

Deere & Mansur Line of Corn and Cotton Planters, Disc Harrows and Hay Loaders.

The world's best. Gold medal winners at every exposition.

We have other beautifully illustrated special booklets. Which one do you want?

More and Better Corn—Booklet. Shows corn planters, etc.

Better Hay and How to Make It—Booklet. Shows hay loaders and rakes.

Alfalfa: Its Seeding, Culture and Curing—Booklet. Shows alfalfa cultivators, seeders, etc.

Bigger Crops from Better Seed-Beds—Booklet. Shows disc harrows, single and double action.

Tell us what implement you want to know about and which one of the special booklets you want, then be sure to ask for the big illustrated book—Package No. X 55

Get Quality and Service—John Deere Dealers Give Both.

JOHN DEERE PLOW CO.

Moline, Illinois



When writing to advertisers please mention The Irrigation Age.



OUR EXPERIENCE IS YOUR SAFEGUARD

I H C Harvesting and haying machines and tools, as sold today, are the result of over fifty years of careful work by trained experts. Through every harvest season these men have followed our machines in the field in every grain-growing country, correcting all difficulties as they appeared or developed.

The binders which are the result of such thorough work are now offered to you with the fullest assurance that when you use these machines your harvesting will be well done. Whatever the conditions under which your crop must be harvested, whether the grain be short or tall, standing, down or tangled, there is an I H C machine which will reap and bind it all; easily, surely, and with no annoying and expensive delays.

I H C harvesting machines as sold today, are a finished product as much as any machine can ever be finished. All the difficulties that have developed up to date are overcome. Our experience is your safeguard. You have no experiments to make. You take no risk when you buy a machine bearing one of these famous names:

**Champion
Deering**

**McCormick
Milwaukee**

**Osborne
Plano**

Take plenty of time to consider, compare all the points of all the machines you know of, before you buy a binder. If you do this thoroughly, you will become convinced that an I H C binder will do the best work for you, be the most dependable, efficient, and durable of all the machines you investigate.

There is quality in the material and construction of I H C harvesting machines that only a half century of experience can assure. There is a simplicity in the design which makes the working of the machines easy to understand and makes it safe to trust them in the hands of unskilled help. Last, and most important, I H C binders are backed by an organization that insures your getting interchangeable repair parts — parts that fit where

they belong — quickly in time of emergency. I H C harvesting machine owners know that if by accident any part of their machine should happen to break, an exact duplicate of that very part can be obtained quickly from the I H C local dealer. This point is of the utmost importance when the grain is ripening or the harvest begun. It does away with all delays, all risks, all possibility of losing part of the harvest profit.

Their many years of constant improvement place I H C harvesting machines in a class by themselves. Whether you choose a Champion, McCormick, Osborne, Milwaukee, Deering, or Plano binder, you are assured of getting a machine built right and tested under every condition that you will ever have to meet at harvest time.

The I H C local dealer handling these machines is the man for you to see. From him you can get information that will help you to make up your mind as to which binder will best insure the full profit of your season's work. Decide only after the most careful consideration and you will surely buy an I H C machine.

When you have decided upon your binder, you will need a supply of binder twine. To get through the season with the least waste and trouble, buy one of the seven perfectly dependable brands of twine — Champion, McCormick, Osborne, Deering, Milwaukee, Plano, or International — in Sisal, Standard, Manila, and Pure Manila grades.

Your most important work now is the selection of machines for this season's harvest. See the I H C local dealer handling these machines. He can help you decide. If it is not convenient for you to see him now, sit down and write for catalogues. A post card will bring you full information.

WESTERN BRANCH HOUSES: Denver, Col.; Helena, Mont.; Portland, Ore.;
Spokane, Wash.; Salt Lake City, Utah; San Francisco, Cal.

International Harvester Company of America

(Incorporated)

Chicago

I H C Service Bureau

U S A

The purpose of this Bureau is to furnish, free of charge to all, the best information obtainable on better farming. If you have any worthy questions concerning soils, crops, land drainage, irrigation, fertilizer, etc., make your inquiries specific and send them to I H C Service Bureau, Harvester Building, Chicago, U. S. A.



ALAMOSA, COLO.

The Gateway to the Resources of the Great San Luis Valley

A Little History:

Founded 35 years ago, Alamosa originally served as a freighting center for large quantities of merchandise which before the advent of the railroad was hauled by wagon and distributed throughout the entire portion of Southern Colorado.

In 1878 the Denver & Rio Grande Railroad penetrated the then undeveloped San Luis Valley, and Alamosa graduated from a freighting center to a Railroad Division point. She has maintained this position, growing rapidly with the development of the valley, until now four branches of the D. & R. G. converge here, running north, south, east and west, connecting with every section of the state. Alamosa's history is the history of a town that has grown safely, progressive and permanent.

That Location:

In seeking a location the two questions most often asked are: What are the conditions? and what is the future? Like all growing communities, we are devoting considerable attention to building our town, and in so doing we have developed conditions which appeal to the homeseeker.

With the wonderful resources of the San Luis Valley as the foundation for the populating of a strip of land as large as the State of Connecticut, and with Alamosa the commercial center, her future is assured.

When you locate don't forget that plenty of clear air and sunshine is essential to health and happiness. Alamosa is blessed with both in abundance.

About Prosperity:

We all seek it. We all hope to find it. Many who have come to the San Luis Valley and to Alamosa have found it and we hope that many more will follow in the footsteps of the fortunate ones. We have open doors of opportunities which are free to those who unlock them. We need some things. Perhaps you have exactly what we need and we have the ways to complete your wants. Investigate and see.

First, we recommend Colorado. Second, we recommend the San Luis Valley. Third, we invite you to Alamosa.

Those Inquiries:

We have had many inquiries concerning Alamosa, and in order to acquaint you with the facts which interest you we have a descriptive book for distribution which is yours for the asking. We are in the business of Town Building. We are interested in you and your needs, and this may be the opportunity you have been waiting for to get in with the right people and the right conditions.

THE THREE WANTS:

Your attention Your investigation Your residence and investment

ALAMOSA COMMERCIAL CLUB J. H. WILSON
Secretary

Printype — OLIVER Typewriter

**The Only Writing Machine in the World
That Successfully TYPEWRITES PRINT
—17 Cents a Day!**

The Printype Oliver Typewriter, which has crowded ten years of typewriter progress into the space of *months*, is now offered to the public for *17 Cents a Day!*

—Offered at the same price as an *ordinary* typewriter—*payable in pennies!*

The commanding importance of *Printype* is everywhere conceded.

For who does not see what it means to make the world's vast volume of typewritten matter *as readable as books or magazines!* The Printype Oliver Typewriter is equipped with beautiful Book Type, such as is used on the world's *printing presses*.

Printype is distinguished by marvelous clearness and beauty. It does away with all strain on eyesight which the old-style *outline* type imposes. Printype puts life and style and *character* into typewritten correspondence. It makes every letter, every numeral, every character "*as plain as print.*"

The complete story of *Printype* has never before been told. Here it is:

The Real Story of Printype

The idea from which "Printype" sprung resulted from the success of our type experts in equipping a typewriter used in our offices to write "The Oliver Typewriter" in our famous trade-mark type just as the name appears on the outside of the machines in all Oliver publicity.

The beautiful appearance and the marvelous clearness of the reproduction of our "ebony" trade-

mark type, disclosed the possibilities of equipping The Oliver Typewriter to *write the entire English language in shaded letters!*

We worked for *years* on the plan and finally succeeded in producing, for exclusive use on The Oliver Typewriter, the wonderful shaded letters and numerals known to the world as "Printype."

The Public's Verdict

That the public is overwhelmingly in favor of Printype is impressively shown by this fact:

Already over 75 per cent of our entire output of Oliver Typewriters are "Printypes."

The public is *demanding* Printype in preference to the old-style type.

Within a year, at the present rate, *90 per cent of our total sales* will be "Printypes."

Thus The Oliver Typewriter, which first successfully introduced *visible writing*, is again to the fore with another revolutionary improvement—*Printype, the type that prints print!*

To Corporations: The Oliver Typewriter is used extensively by great concerns in all sections of the world. Our "17-Cents-a-Day" plan is designed to help the large class of typewriter buyers who want the same typewriter that serves the great corporations, but prefer the easy system of purchase.

The masses want The Oliver Typewriter because it stands the test of the largest corporations.

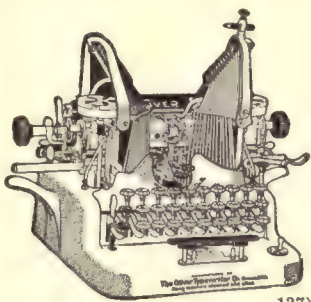
Meet "Printype"—You'll Like Its Looks

Ask for Specimen Letter and "17-Cents-a-Day" Plan.

Make the acquaintance of Printype, the reigning favorite of typewritedom. Ask for a letter written on The Printype Oliver Typewriter, which will introduce you to this beautiful new type. We will also be pleased to forward the "17-Cents-a-Day" Plan on request. Address Sales Department,

The OLIVER Typewriter Company

000 Oliver Typewriter Bldg., Chicago



137)

Hollow Core Wall for Hydraulic Fill Dams

In a Hydraulic Fill dam the problem of the drainage of the sluicing water is of controlling importance. The sluiced material should be such that it will not retain the sluicing water for an undue time. If the material is such that it will not deliver the water with reasonable rapidity a decided settlement with consequent cracks is bound to ensue when the fill ultimately dries out.

The sluicing water on the fill is maintained in a summit pool by hand-made levees. It is found that in depths downwards to 5', the material in suspension becomes comparatively solidified and it will then hold its shape and consistency. The sluicing water, however, must necessarily be under constant drainage if rapid construction and solid banks are expected.

A Hydraulic Fill dam during construction generally has water in the impounding reservoir above it which rises at substantially the same rate as the increasing height of the dam, but a little below its level, thereby reducing the drainage head in that direction. Assuming that there is no core wall, the sluicing water is forced to pass largely through the down stream fill unless drainage tubes in some form are provided. The passage of the drainage water through such a mass of material is slow, and hence full advantage cannot be taken of the otherwise rapid method of hydraulic construction.

Again, the material of the fill will not take its final set until the fill is complete. The fill is therefore saturated during construction, and saturated material is always of greater bulk than dry material. This fact accounts in a measure for the excessive settlement in hydraulic fills.

All this is controlled by building a Hollow Core Wall through the center of the embankment, and providing it with numerous drainage gates of simple construction. A facing of broken stone or gravel should be placed next to the upstream face of the core wall.

It is evident at a glance that with this construction we have accomplished two things:

First, we have provided an effectual water-barrier whereby when the lower prism of the dam is once drained it is forever protected against re-saturation.

Second, the problem of drainage is entirely under control and can be hastened or retarded at will. Drainage head is secured in two directions, namely, towards the core and towards the toe. The material more quickly receives its final set and unexpected settlement is thereby avoided. The time of construction is greatly hastened.

Moreover, in the usual form of construction the levees on the outside edge of the pond frequently give way and permit a localized washout on the slope of the fill. The central drainage into the Hollow Core Wall permits of instant relief of excessive water and makes a washout impossible.

Again, if the sluicing material is such that it settles rapidly, the surface water can be quickly drawn off into the Core Wall.

Once the fill is completed the drainage gates into the Core Wall from the lower prism are permanently opened. This insures an absolutely dry prism; a result never before reached.

The above is a mere outline of the functions of the Hollow Core Wall in relation particularly to the Hydraulic Fill during construction. The advantages named in a previous advertisement in connection with an ordinary rolled earth dam apply in full to the Hydraulic Fill when the same is completed and in permanent service.

The above notes are fairly illustrated by the sectional drawing herewith presented which roughly represents a Hydraulic Fill Dam in process of construction. The Hollow Core Wall is carried up to and a little above the ultimate embankment and provides interior inspection through the heart of the fill.

This topic is more fully treated in our Circular on EARTH DAMS. (This circular is now in preparation and will be issued during the month of May.) The introduction of the Hollow Core Wall entirely changes the basic problem of an earth dam, whether of rolled earth or hydraulicked into place. These points will not admit of discussion in an advertisement.

Respectfully submitted,

AMBURSEN HYDRAULIC CONSTRUCTION CO.
ENGINEER-CONSTRUCTORS, 88 Pearl St., Boston, Mass.

All inquiries from Canada should be addressed to

Ambursen Hydraulic Construction Co.,
405 Dorchester St., West, Montreal, P. Q.



HYDRAULIC FILL DAM WITH HOLLOW CORE WALL
IN PROCESS OF CONSTRUCTION.

NOTICE OF SUIT IN INFRINGEMENT

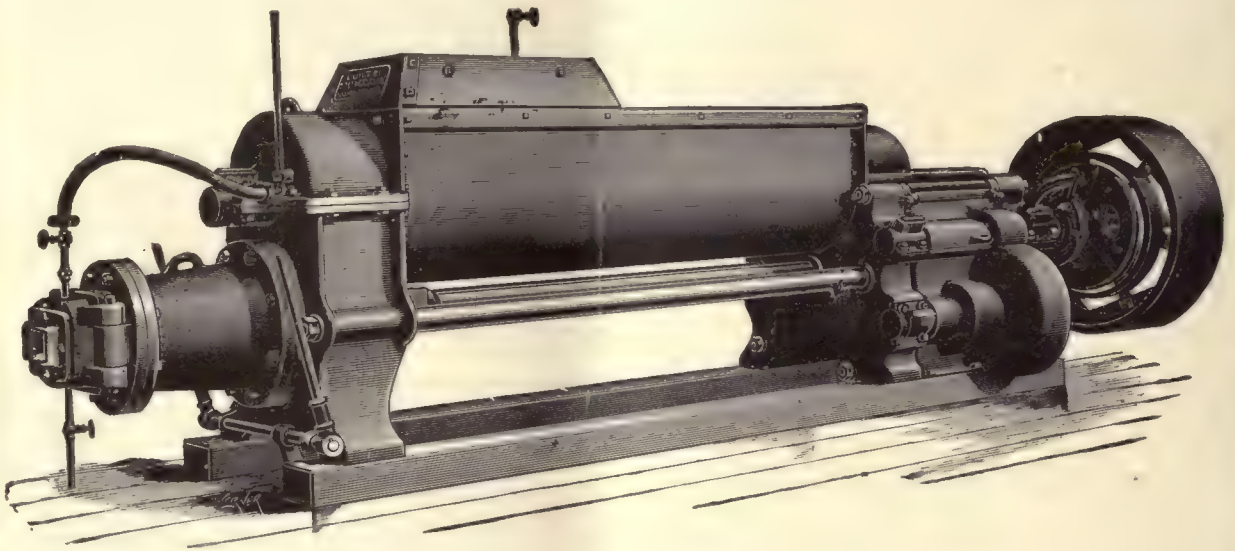
Notice is hereby given that on April 9, 1912, we brought suit in the United States District Court for the Southern District of New York against the Hydraulic Properties Company of New York, to restrain the infringement of our Re-issued Letters Patent, 12,246, which cover broadly the type of dam now known as the "Ambursen Reinforced-Concrete Dam" or otherwise as the "Hollow Dam."

For the past seven years our patent rights have been generally respected and licenses have been granted by us whenever conditions made it impossible for us to execute the work with our own force. The aggregate of royalties received by us during this period, and particularly within the last two years, has amounted to a very large sum of money—much of this by pre-arrangement but a considerable portion after the fact of infringement and under more or less pressure. We wish it clearly understood when we execute the work ourselves, no royalty, concealed or otherwise, is introduced into our charges.

Owing to the marked success which has attended the construction of the Reinforced Concrete Dam by this Company, and stimulated apparently by the belief that we were indifferent to our patent rights, infringements in various parts of the country are apparently multiplying. We therefore give public notice that from this date we shall vigorously defend our rights and prosecute all infringers.

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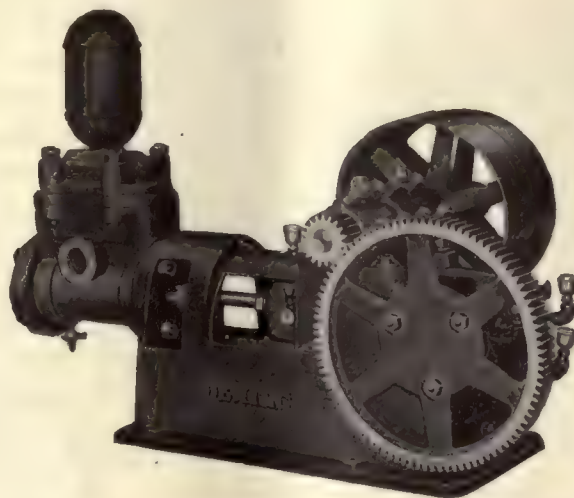
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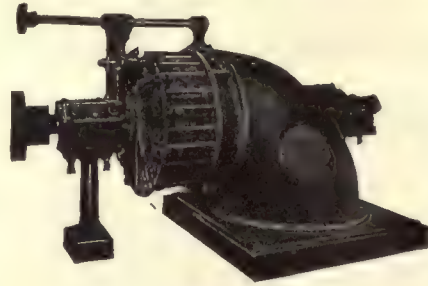


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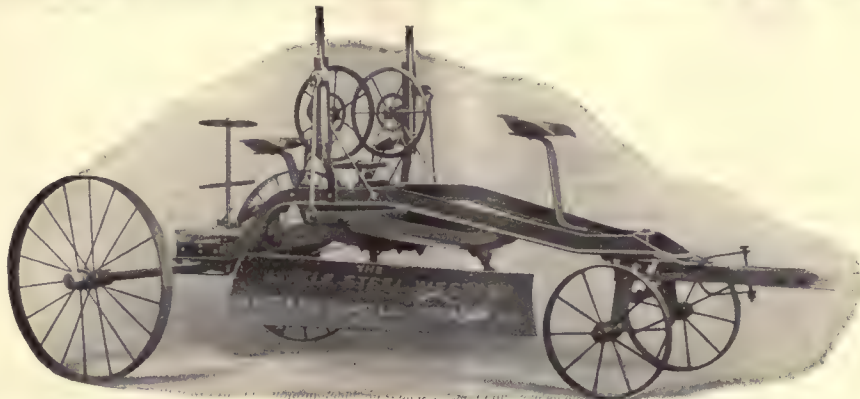
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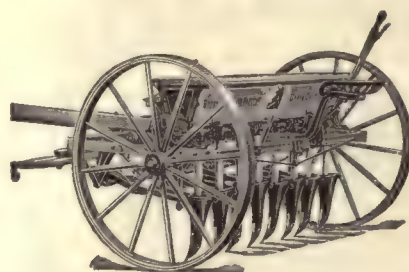
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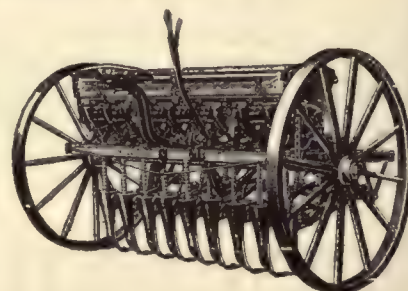
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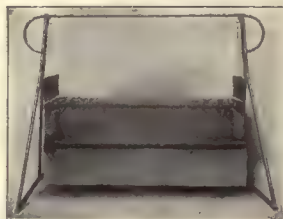


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THE IRRIGATION AGE

VOL. XXVII

CHICAGO, JUNE, 1912.

No. 8

THE IRRIGATION AGE

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THE IRRIGATION ERA
ARID AMERICA

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MID-WEST
THE FARM HERALD

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old and is the pioneer publication of its class in the world.

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Helping the Western Settler

The note of warning sounded by THE
IRRIGATION AGE, in its April issue, calling
attention to the danger threatening the
United States by the heavy immigration
to Northwestern Canada, has helped to
arouse considerable agitation and some
definite work has been started to counteract the same.

At a recent meeting in Chicago this subject was dis-
cussed by representative men, intensely interested, and
much useful work has been done toward relieving the
situation. The fact was brought out that the govern-
ment has not done its full share to give out information
in regard to the lands to be settled and especially to the
reclaimed lands in the West.

It is to be hoped that in the near future the Depart-
ment of the Interior will take a definite stand in this
matter and establish a special bureau of colonization for
the purpose of disseminating correct information regard-
ing all lands open for settlements in the United States
and possessions; in addition to this it should be the
further duty of the bureau to watch for any one selling
or offering for sale private lands, to see that no misrep-
resentation of facts are made to intending settlers; and
to bring any one persisting in giving false information
to any one to justice.

It will require further modified laws pertaining to
homestead and colonization acts, modifications of the rules
for taking up desert and reclaimed lands in order to re-
lieve unnecessary burdens which these laws impose.

It is a good sign to note that some progress has

been made in this direction by the new law providing for a three-year occupation of the homesteads instead of five years as heretofore—which has quite recently been passed by Congress.

Let the good work go on, and let every citizen of this great country help to make it a success.

How to Regulate Trusts.

The termination of the recent trial of the Beef Trust under the Sherman Anti-Trust Act proves conclusively that that law as now on the books does not bring the relief contemplated, nor have any former results of prosecutions under this act shown any practical results. It may be set down as a fact that this law does not fit into modern conditions and the quicker it is repealed and proper legislation enacted the better it will be for all concerned.

The sudden rise of the securities of the packing interests and the immediate boosting of meat prices followed in the wake of the failure of the Government to convict and showed its utter helplessness.

There is no one in this whole United States who doubts that there exists a packing trust which dictates at all times the prices to be paid for stock to be butchered and also the prices to be paid for the finished product, yet no remedy seems possible except perhaps that of adopting a vegetarian diet, and thus boycott the packing firms. This, of course, is not a very desirable method to fight the beef trust, as cold storage and embalming fluids would preserve their product indefinitely, visiting afflictions upon future generations.

There is, however, a promising remedy which might be developed to cope with the trust evil; which will keep the bad trusts in due bounds and which will not injure beneficent trusts; for it is nowadays understood that *not all trusts* are bad. As a matter of fact it would be bad policy to dissolve *any* trust, since it would be going backwards in our civilization; trusts have developed methods by which our work may be done quicker, better and cheaper and for these reasons we should foster them, if anything. But we don't want any bad trusts—trusts that take advantage of the man who sells the raw material, by grinding him to a figure below a decent living, that hire their operatives at a starvation wage and that sell their product at the highest possible figure the public will stand for.

The remedy to be applied in such cases is to take Mister Trust in hand and ask him to please be good—and here is where the duty of Congress is pointed out, that instead of passing laws forbidding trusts, it should pass laws to *regulate* them, just as they did with the railways of the United States by the establishment of the Interstate Commerce Commission. We don't need to go any further at all, but look at the work and the results of this commission, which say that it has filled the bill and that the Transportation Trust has been pretty well controlled by the Government, although even this commission might be improved.

In order to get not too far into this subject, we will just consider the Packing Trust and suggest how it can be regulated by the Government. A commission should be appointed, a National Packing Commission, whose duty should be to study into every phase of the packing industry and to carefully determine the cost of the products. Then it should have the power to fix the selling price of

such products to the consumer, allowing for a proper profit to the packing firms.

In this way the packers would quit taking advantage of the stockmen and would pay reasonable prices for the stock offered in the market; they would pay living wages to their employes, as there would be no object in their cheapening the cost of production, and the consumer would obtain his meat and other products of the packers in good condition and at a reasonable cost. A commission of this kind would naturally have far-reaching powers and duties, as it would have to watch many related points, such as over or under production of raw material, the consumption in the United States and export to foreign countries. But there can be no doubt that the idea is feasible and in view of late experiences it should be tried. Food products are just as essential to the welfare of communities as transportation facilities; why, then, should their production and distribution not be regulated in a similar manner?

Co-operation Practical In Farming

The age of individualism is passing away slowly but surely. The time was when each village had its shoemakers, tailors, blacksmiths and other craftsmen, each of whom worked independent of the other and enjoyed a secure livelihood in the exercise of his calling. But the last two decades have brought sweeping changes and the independent tradesmen have been practically wiped out by the organization of great firms who are producing shoes, clothes, etc., on a large scale by the use of greatly improved machinery.

The individual tradesman cannot compete with these aggregations of capital and he has been compelled to join the ranks of the operatives in the factory where he runs a machine to produce a particular unit in the product which formerly he created himself as a complete unit.

Whether these changed conditions are truly desirable and beneficial we do not pretend to either affirm or deny, so much is certain that the cost of production has been lessened, and that fact approves them from the economic point of view.

While these industrial revulsions and changes have been going on all over the world, the agricultural conditions have undergone very little change, although in isolated cases bonanza farms have been operated on a large scale requiring the employment of considerable capital. The average farmer, however, is plodding on the same way as he did centuries ago, working his homestead and being king of his possessions.

Even though he has adopted modern methods and machinery the advantage of doing things on a large scale is lost to the small farmer. The big traction engine doing the work of fifty or sixty horses economically, he cannot use as his land holdings are too small and he must use either smaller engines or horses, both of which are more expensive to operate and maintain.

These considerations suggest co-operation of a number of farmers whose lands adjoin and are similar in character. Thus twenty farmers, each having 30 acres of land, might form one concern operating a 600-acre farm on the same lines as one large land owner would do, and thus reap the benefit of economical operation. These twenty farmers would then really be stockholders of a farming corporation, merging their lands and interests into a common one, everyone furnishing the same amount of capital and labor and participating equally in the net profits of each year's crop.

This plan seems particularly adaptable and advantageous to settlers in irrigation districts where the conditions of the land of a large number of holders are very uniform and thus permit to be worked by machinery on a large scale. It would also permit people living in cities to share in the benefits of profits accruing from the operation of such farms by paying their pro-rata assessments in cash, thus furnishing capital for the maintenance of resident workers. Then the workers on such a co-operative farm could divide the work so that each of them would do the work he is best qualified to do; there might occur friction along these lines, but when every stockholder is interested in the success of the venture, then the majority of them will be sure to take the right action and settle all grievances in the right way.

The various water organizations in irrigation districts are communities of common interests; they should try co-operative farming and selling of their products and they will find that their work will be considerably easier and their profits greater at the end of the year.

The organization must, however, be effected along conservative lines, based upon equity and honesty.

Study Foreign Irrigation Methods

There are just now a number of prominent engineers and irrigation experts from Germany and France inspecting the reclamation work of our government in the arid West, and it is stated that they will remain several months in this country for the purpose of investigating our methods of irrigation, drainage and utilization of water power.

Only recently a prominent engineer from Russia spent considerable time in studying our irrigation plants, and other countries have sent representatives on numerous occasions for this same purpose as our readers will remember Mr. McIntosh last summer, who came from Australia, and Mr. Kadam, who came from East India.

These facts evidently show that countries who are further advanced than our own feel that there are things which they might learn from this country and are willing to spend money to obtain such information.

This is an opportune moment to ask the question, whether or not it would be to the interest of this country to do likewise and send competent representatives to foreign lands to study the progress of reclamation there and bring home a store of useful knowledge which should be used in improving the conditions in this country.

We say to send *competent* representatives, which means that politicians are not wanted on such an errand. The example set by other countries should be followed closely and only men of the proper training, knowledge and experience should be selected for such purposes.

There can be no doubt that our country would be greatly benefited if we would send representatives to study methods in use in other countries; the average American citizen is impressed too much with the idea that there is no improvement possible on his methods and that he cannot learn anything from what is being done abroad. The quicker we get rid of this idea the better, and if we desire to keep up with the procession we had better keep our eyes open and see what is going on elsewhere in the world. The foreign engineer and reclamation expert who comes to this country studies

our methods and is quick to see where we are ahead of his country and will fully embody it into his report. But he likewise sees our shortcomings and where his country is far ahead of us; of course he will be too polite to call our attention to it and will pat us on the back and tell us how wonderfully smart we are. When he gets home the points of superiority are carefully considered and adopted, but the deficiencies are secretly considered as a disadvantage to America, and consequently an advantage to his own country.

This shows the necessity of our country to do likewise and send periodically men of noted ability and experience to visit foreign lands for the purpose of comparing methods of irrigation, drainage and power development as observed abroad with our own and come home making full reports showing both advantages and disadvantages of American practice.

Experiment Station Work Necessary

Elsewhere we are publishing a very complete essay on the spraying of apple orchards, which has been abstracted from bulletin 119 of the Agricultural Experiment Station of Nebraska. The article goes quite thoroughly into the matter and gives full details how to manage this important work. It gives full information how to mix the various fluids for the different purposes and how to apply them, so that it will pay the reader to either write for the bulletin referred to, or to carefully preserve this issue of the IRRIGATION AGE, for his guidance in sprinkling the apple orchard. The whole subject is treated in such a clear and concise way and is so carefully illustrated that even an inexperienced apple grower should have little difficulty in arranging for a satisfactory spraying outfit and to apply it in a practical and successful manner.

Here is again, an instance where the practical value of experiment station work is illustrated showing how useful such investigations are, and the necessity of such further work in other directions. With all that already has been accomplished, we may say that we have just entered upon the threshold of progressive farming and horticulture, and that our progress henceforth will be much greater with very much increased practical results. When science and practical work go hand in hand as they do now to determine the best methods in producing crops, success is assured. All we need to do is to help the work along and support the agricultural colleges and experiment stations in their useful work that they are now doing, and in helping efforts to extend such work more and more, by asking the government for more of such colleges and stations. Each state in the United States should have at least one experiment station, and the more prominent agricultural states should have a fully equipped college for the study of agriculture and all its allied branches.

Thoughts That Come and Go

A Bureau of Colonization will be a very desirable thing for Uncle Sam to organize. It will help to keep the folks at home and incidentally prevent the exportation of many millions of money into Canada.

* * *

The Department of the Interior should be in charge of this bureau and should put its most capable men at work to make it effective.

Uncle Sam can well afford to spend a million dollars a year for the purpose of settling up the vacant lands of his domain rather than let our people emigrate into foreign countries.

* * *

The change from five years' residence to three years for proving up on a homestead is a very good one and will help to bring in settlers on the irrigation projects of the government.

* * *

The United States is holding the best and most desirable parts of America but Uncle Sam seems to have been afraid to state that fact.

* * *

Some of our neighbors are not at all bashful to publish all desirable features of their holdings, carefully abstaining to call attention to any drawbacks.

* * *

Just the same if we want to hold our own or want to draw new blood from elsewhere inducements must be offered.

* * *

The crop of water has been abundant this year as the lower Mississippi Valley is willing to attest.

* * *

By the way that brings up the question how is the problem of protecting the overflowed valleys of this country to be solved?

* * *

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TO HELP IN COLONIZING THE WEST.

An important meeting was recently held in the Federal building, Chicago, to consider the problem of providing settlers for the West and particularly for the many irrigation tracts which are now finished but await the coming of the husbandman. Mr. Newell, director of the United States Reclamation Bureau, was instrumental in calling the meeting which was largely attended by railway men and land owners, also irrigation officials. Mr. Newell stated that of the one million acres of land reclaimed by the Government only one-third is utilized today and that much of the dissatisfaction of settlers or intending settlers is due to misrepresentations made by irresponsible parties. As a remedy he recommended the establishment of a National Bureau of Colonization which would give impartial and correct information to all settlers.

IMPORTANT CHANGES IN REGULATION.

The Secretary of the Interior has put into effect a number of important modifications of the regulation governing the assignment of homestead entries within irrigation projects.

A settler is now permitted to assign any part of a farm unit with the approval of the project engineer

upon the filing with the local land office of a plat of amended farm unit approved by the engineers with the other papers. When one-half of the irrigable area has been reclaimed the entryman may make proof of reclamation without regard to the number of payments of the building charge which have been made and will receive evidence of the acceptance of such proof. Provision is made for recording mortgages which will facilitate the making of loans and at the same time protect the money lenders. It is believed that the new regulation will result in a great improvement of the conditions on many of the government projects where the settlers have been severely handicapped through lack of funds by reason of inability to borrow money on their lands.

A USEFUL CORPORATION.

Many of our readers will be interested to know that the Irrigation Service Company of Fort Collins, Colo., has been incorporated for the special purpose of protecting the investor in irrigation securities and thus to help restore confidence in good reclamation projects.

There have been some successful promotions of doubtful projects, to which fact is due the present condition of the market for irrigation securities which, however, shows signs of improvement.

Greater care should be exercised by investors to the end that only absolutely GOOD projects receive financial assistance. The officers of The Irrigation Service Company have been actively engaged for a period of ten to twenty-five years in irrigation engineering, construction, management and financing, and are therefore quite competent so far as the opportunity is offered to the business of safeguarding to pass judgment and safeguard irrigation investments.

THE "WHY" OF THE BIG FOUR "30."

The above is the title of a neat book of 141 pages of reading matter treating upon the principles governing the Internal Combustion Motor. The book is intended as a guide and teacher for those especially handling machinery made by the Gas Traction Company of Minneapolis, Minn., which company is publishing the above named work and from whom it may be obtained for the small sum of one dollar. The information contained in the book is of a high character, and the text is written so clearly and the illustrations are so plain and thorough that anyone who is able to read can study the construction and care of gas traction engines and we recommend the book to anyone who has anything to do with a gas engine or a gas tractor.

INFORMATION WANTED.

D. H. Anderson,

Chicago, June 3, 1912.

Editor IRRIGATION AGE.

Dear Sir:

Can you give me any information through the columns of the AGE about an irrigation district in s. e. Colorado called the Bent & Prowers Irrigation District, comprised of parts of Bent and Prowers counties?

How far has the project advanced, and is it likely to be completed?

Yours, etc.,

C. D.

This is evidently a private project, as it is not mentioned in the "Government Reclamation Record" and we will appreciate if any one of our readers in that section of Colorado will send us the desired information.—Editor.

RENEW YOUR SUBSCRIPTION PROMPTLY.

Do not delay to remit One Dollar for renewal of your subscription to THE IRRIGATION AGE. You cannot get along without it.

SPRAYING AS AN ESSENTIAL PART OF PROFITABLE APPLE ORCHARDING*

By R. A. Emerson, R. F. Howard, and V. V. Westgate

In 1906 the Experiment Station, in co-operation with the United States Department of Agriculture, began a series of spraying demonstrations in eastern Nebraska apple orchards. In 1907 the work was continued by the Experiment Station alone and in 1908 the work was again conducted jointly by the Experiment Station and the United States Department of Agriculture; in 1909 and 1910 the Experiment Station

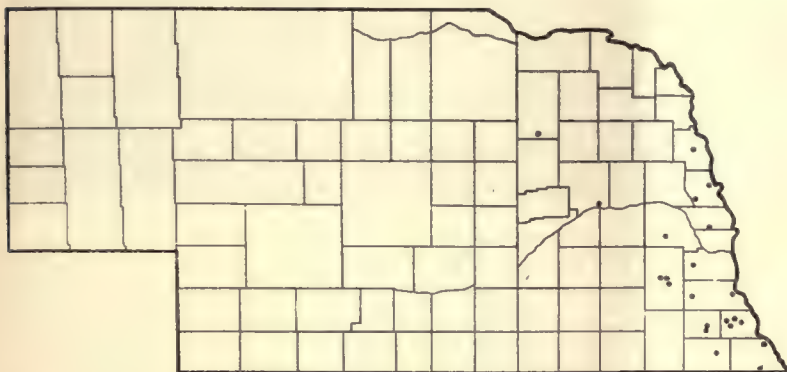


Fig. 1. Showing distribution of orchards in which spraying tests were carried on.

was alone in the undertaking. The work of the last three years has not been reported previously. During the five years, demonstrations have been made in twenty-two orchards, representing eighteen localities in thirteen counties. That the orchards selected were well distributed over the eastern part of the state can be seen by reference to the accompanying map.

Before the work was begun it was well known that it was possible by proper spraying to control scab and codling moth, the most generally troublesome pests of apple orchards in this state. There was available, however, very little definite information regarding the cost of spraying or the profits to be derived from it under our conditions. The majority of farmers made no attempt at spraying. Many of the more prominent commercial orchardists, even, were trying to produce apples without spraying, and those who were spraying more or less regularly were, with few exceptions, not sufficiently thorough in their work to get the best results. On account of the lack of knowledge of the proper means to employ in combating the common orchard pests, many orchardists had come to believe that apple growing was not a profitable business. And under the conditions prevailing in many orchards, this was a perfectly correct conclusion.

It was therefore planned from the start not merely to demonstrate the possibility of controlling apple insects and diseases but also to determine whether they could be controlled profitably. To accomplish this it was necessary to know exactly what it cost to spray, what sprayed fruit yielded, and what it was worth in comparison with unsprayed fruit from the same orchards. In every spraying demonstration the time spent in mixing and applying the materials and the quantity of material used were recorded. The cost of labor of men and teams per hour was taken at the orchard owners' estimates and the cost of materials was charged at the prices actually paid by the orchardists. In every orchard a block was set apart for the demonstration spraying, and another block, in every way comparable with the first, was left without spraying as a check on the results of spraying. The exact yields

of both marketable and unmarketable fruit from the sprayed and from the unsprayed blocks, or from considerable parts of them, were noted. The net value of the fruit was determined by deducting from the actual prices received by the owners the estimated cost of picking, grading, packing, hauling, etc. The net value, therefore, was what the fruit was worth on the trees.

The work was done under all sorts of conditions. The trees varied in age from ten years to twenty-eight years and averaged about eighteen years. In some orchards they had been well pruned, but in more cases they had been pruned little or not at all for some years. In some cases the spraying was hindered by the closeness of the trees and in others by a secondary crop of bush fruits. In some orchards, on the other hand, the trees were conveniently spaced and the ground was free from troublesome bushes. A few orchards had

every convenience for mixing and applying the spray materials while others were almost completely without such conveniences. Take for instance a case where it was necessary to go a half mile or more from the orchard to get water for spraying and where it was then necessary to pump it by hand and lift it up to the spray barrels in buckets. Contrast this with the cases where the mixing stations were near the center of the orchards, where a sufficient supply of water to spray a considerable part of the orchard was held in a large tank filled by a windmill or gasoline engine, and where the supply tank, dilution tanks, etc., were on platforms higher than the spray wagon so that the mixtures simply ran down into the spray tank. Under the first set of conditions it often cost more to mix the spray and get it to the orchard than to apply it, while under the second set of conditions little time was spent in mixing and

hauling the spray. Some orchards were provided with efficient gasoline power spray pumps mounted on trucks carrying large spray tanks, overhead platforms, and the like to facilitate the work. The other extreme was a poor hand pump with which it was barely possible to maintain pressure for one spray nozzle. The cost of spraying naturally bore



Fig. 2. Type of barrel sprayer, suitable for a home orchard.

*Abstract of Bulletin 119, Agricultural Experiment Station of Nebraska.

a very direct relation to the facilities for work in the various orchards.

Not only did the somewhat unfavorable conditions noted make spraying more costly than necessary, but the rather poor average condition of the trees, mostly from crowding and lack of pruning, reduced the average yield of choice fruit materially and indirectly increased the relative cost of spraying. That is the cost of spraying per bushel of good fruit produced was considerably greater than it would have been had the trees been in better condition. In one orchard, for instance, over half the Winesap apples from the sprayed block were graded as No. 2. Though almost entirely free from scab and codling moth, many of the fruits were small and poorly colored because of a lack of proper pruning. That same season the same variety in another orchard of the same age on similar soil and not far from the first produced fruit, nearly all of which, from the sprayed block, graded No. 1, not because it was more free from scab or codling moth but because it was of much better size and color. The trees in this second orchard had been more thoroughly pruned than the trees in any orchard in which spraying demonstrations were made.

Of the five seasons covered by these spraying tests, three have been unfavorable owing to the prevalence of killing frosts at blossoming time. The yields of fruit secured have not, therefore, been so favorable as they would have been under more nearly average conditions. The prices received for the fruit have, however, been good on the whole, in part at least offsetting the rather poor yields. Moreover the difference in value between the sprayed and the unsprayed fruit has probably been as great as it would have been in more favorable seasons because of the fact that spraying seems to increase the yield of fruit more in an off year than in a good fruit year.

The following statements give a summary of the results obtained from the first four years' work:

COST OF SPRAYING.

Number of orchards sprayed, 10.
Total number of trees sprayed, 3,300.
Average age of trees, 18 years.
Average number of sprayings per year, 4.
Average quantity of spray per tree each year, 13 gallons.



Fig. 3. A barrel sprayer outfit in operation. Columbus orchard, 1910.

Average quantity of spray per acre (50 trees), 650 gallons.
Average cost of spray material per 100 gallons, \$0.87.
Average cost of applying spray per 100 gallons, \$0.98.
Average total cost of spraying per 100 gallons, \$1.85.
Average annual cost of spray material per tree, 11.3 cents.
Average annual cost of applying spray per tree, 12.7 cents.
Average total annual cost of spraying per tree, 24.0 cents.
Average total annual cost of spraying per acre (50 trees), \$12.00.

RESULTS OF SPRAYING.

Average annual yield and net value per tree—
Sprayed trees:
Marketable fruit 4.4 bushels at 52 cents. \$2.28
Culls and windfalls 1.1 bushels at 6 cents. .07
Total 5.5 bushels at 43 cents. \$2.35
Brought forward \$2.35
Unsprayed trees:
Marketable fruit 1.8 bushels at 41 cents. \$0.73
Culls and windfalls 1.7 bushels at 5 cents. .08
Total 3.5 bushels at 23 cents. \$0.81
Difference between sprayed and unsprayed trees. \$1.54
Average cost of spraying24

Average net gain from spraying \$1.30
Average annual yield and net value per acre (estimated on basis of 50 trees)—
Sprayed trees:
Marketable fruit 220 bushels. \$114.40
Culls and windfalls 55 bushels. 3.80

Total 275 bushels. \$117.70
Unsprayed trees:
Marketable fruit 90 bushels. \$36.90
Culls and windfalls 85 bushels. 4.25
Total 175 bushels. 41.15

Difference between sprayed and unsprayed trees. \$ 76.55
Average cost of spraying 12.00

Average net gain from spraying \$ 64.55

The records reported here—records secured under actual farm conditions—show that spraying pays twice its cost by increasing the yield of fruit and three times its cost by both increased yields and improved quality. The gain due to spraying one-half acre of apples one year will, on the average, buy a good barrel-pump, 50 feet of hose, two extension rods, two nozzles, and five barrels for use in mixing spray materials. The sprayer will last several years and can be used to fair advantage in orchards up to five acres. The gain from the proper spraying of five acres one year will, under average conditions, pay for a power outfit, including a small gasoline engine, pumps, rods, nozzles, hose, 250-gallon spray tank, elevated spray platform, and the truck on which to mount the whole outfit. One such power sprayer is ordinarily sufficient for an orchard of 20 acres and is often used in orchards of more than twice that size.



Fig. 4. A convenient type of mixing apparatus, showing stock solution barrels, dilution tanks, and elevated water power.

CO-OPERATION IN SPRAYING SMALL ORCHARDS.

For the most part, the commercial orchards of the state are now being sprayed. On the other hand, the small home orchards that receive this attention are exceptions rather than the rule.

Nearly every farmer in eastern Nebraska has fruit trees growing about his place, though he may consider this a very minor phase of his farming business. The mere fact that fruit growing is incidental to his general farming, coupled with the seeming trouble of mixing and applying the materials, is why these small orchards are neglected. Early in the spring is the time when there are many things demanding the farmer's attention. This is the time also when the important sprayings have to be made if the apples are to be protected from codling moths and scab. The average man with an acre or two of orchard does not feel he is justified in spraying it if his other work is interrupted. This same man would probably appreciate sufficiently the difference between sprayed and unsprayed fruit so that he would be willing to pay a reasonable price to have some one else spray his fruit.

If some method were introduced whereby these small orchards could be sprayed, a great need would be met. Spraying outfits could be run on the same plan that threshing machines are operated in this state. The figures given above might be used as a basis for determining the charge. A five- or ten-acre orchard is enough to justify a man in getting a power sprayer. The capacity of such a machine is easily twenty acres. Under these conditions the owner of the outfit might co-operate with fifteen or twenty of the small orchard owners in his immediate locality to the extent of spraying their trees. He could in this way make his machine pay for itself, besides reducing to a minimum the possibility of infection to his own orchard from outside sources.

MIXING AND APPLYING SPRAY MATERIALS.

The two pests of chief concern to apple orchardists at the present time are the apple scab and the codling moth. All careful experimental tests have shown that it is possible to keep both of these pests under control by spraying, providing the sprays are properly mixed and applied in sufficient quantity at the right times. As one of these pests is a chewing insect and the other a fungous disease, the same spray will not do for both.

For apple scab, some fungicide is necessary—the common one being Bordeaux, although lime-sulphur is beginning to be used considerably as a fungicide. Bordeaux mixture is composed of copper sulphate (bluestone), lime and water—the copper sulphate being the active agent. Various formulas, containing these materials in different quantities, have been tried. At present, the 3-3-50 formula is believed to be sufficiently strong to kill the germinating spores of apple scab. This formula is made up as follows:

Three pounds of copper sulphate (bluestone).

Three pounds of lime (unslacked).

Fifty gallons of water.

The lime that is used in the spray neutralizes the injurious effect of the bluestone and it also causes the spray material to adhere better to the foliage. In making Bordeaux, it is necessary that the lime and copper sulphate solutions be kept separate until they are ready to be united in the sprayer. They should also be mixed together in dilute and never in concentrated form if best results are to be expected.

In some rather recent experimental tests, we have found commercial lime-sulphur to be a good fungicide. This material can be purchased on the market in concentrated form. As a summer spray for apples, about a gallon of the concentrated solution is mixed with 30 gallons of water.

Sometimes self-boiled lime-sulphur is used as a fungicide, especially for the second spraying, since it does not "russet" the fruits as does Bordeaux. As this spray is gradually

becoming of more importance, it is advisable to consider a few points in its preparation. This self-boiled lime-sulphur is mainly a mechanical mixture of lime and sulphur—the only heat used in its preparation being that generated from the slacking lime. In making it, flowers of sulphur and good unslacked lime are used. As a common spray for apples, this mixture should be used in the proportion of ten pounds of lime and ten pounds of sulphur to 50 gallons of water.

In mixing self-boiled lime-sulphur, place the proper amount of lime in a barrel and pour on water until the lime is almost half covered. The sulphur should be run through a sieve to break up the lumps, and, as soon as the lime begins to slack, the sulphur should be added to it. Enough water should then be added to the mixture to facilitate the stirring but not enough to check its boiling. Allow the mixture to cook until the lime is well slacked, about 10 to 15 minutes; then add enough water to prevent further boiling. The mixture is then ready to be strained into the spray tank and diluted for use. If made in rather large quantities, say 30-30-150, better cooking will result.

SPRAYING CALENDAR.

The first spraying is chiefly for apple scab and of course for this Bordeaux or lime-sulphur alone is sufficient. If the canker-worm should be working on the foliage of the trees at the time of the first spraying, which does occasionally happen, the poison should be added to the fungicide. The first spraying is given just as the leaves are beginning to develop. Because of the open condition of the trees at this time, the sprayer can thoroughly coat the twigs and expanding leaves with spray, which should be done.

The second spraying, given when the petals have fallen, is the most important of all applications. It is always the most important spraying for the codling moth, and in a good many years it is the chief one for apple scab. This second application should also be the heaviest one given. As the trees have a mass of foliage that must be thoroughly covered, we shall find the spray dripping from the trees after the job is completed. Under normal conditions the first flowers will be the ones to set fruit. For that reason the second spraying may have to be given before the petals have fallen from the late blossoms in order to fill the closing calyx cups with the poison. However, a too early spraying is undesirable, as it would kill many bees which are pollinating the blossoms. The reason for thoroughly filling the calyx cups is that a large number of the codling moth larvae will enter the apple through the calyx. In careful tests, it has been found that fully 75 to 80 per cent of the larvae enter in that manner. Although the eggs of the moths are not hatched until two or three weeks after the second spraying, if a sufficient amount of spray has been placed in the calyces at this second spraying, enough will be held there to destroy the larvae as they enter. Strong Bordeaux at this spraying will be apt to "russet" the fruits.



Fig. 5. Mixing apparatus, showing method of combining the streams from dilution tanks before they enter the sprayer.

For that reason, a weak solution, two pounds of copper sulphate to 50 gallons of water, is preferable, or, even better, one or the other of the lime-sulphur sprays described elsewhere in this bulletin.

The third spraying is applied just about the time the eggs of the first brood of codling moths are hatching. By coating the foliage and fruits with spray at this time, a large number of the worms will be killed. This spraying is especially valuable for destroying those larvae which may attempt to enter the apple at some point other than the calyx.

Apple scab largely spreads about the time of the first, second and third sprayings. If the weather is hot and dry during this period, the germination of the spores is retarded, and in such a season apple scab does little damage; but if we have moist conditions the disease thrives. As we do not know in advance what weather conditions will be, the only safe plan to follow is always to make the first three sprayings with the fungicide. As scab is not developing when the fourth spraying is made, it means a waste of material to apply Bordeaux. Lead arsenate, mixed at the rate of $1\frac{1}{2}$ pounds to 50 gallons of water, should be used at this time,—which is for controlling the second brood of the codling moths. Carefully mixing and applying the second and third sprayings means that comparatively few larvae of the first brood will escape, hence the second brood would be few and would cause but little trouble. For that reason, it behooves the orchardist to be unusually careful with the earlier sprayings. At times in the past, a fifth spraying has been recommended, but certainly it is not very essential, providing the earlier sprayings have been properly given. Where a fifth spraying is made, it should be with the insecticide alone and should be applied three to four weeks after the fourth.

In general the person who has a small orchard will use somewhere from 100 to 500 gallons of the mixture in each average spraying. For such small amounts it will be preferable to mix the spray material in 50-gallon lots. Take four pounds of copper sulphate (otherwise known as bluestone or blue vitriol) and dissolve it in a half-barrel (25 gallons) of water. To do this, place the copper sulphate in a common gunny sack and hang the sack in the barrel so that the sulphate will be partially submerged in the water. By using this scheme, one gets the bluestone to dissolve more quickly, as the more concentrated solution is always at the bottom of the barrel.

Also slack four pounds of lime in a second barrel. At first use only enough water to slack the lime. When it has slacked, add enough water to make 25 gallons of the mixture. The copper sulphate and lime solution should be poured together into a third barrel or they can be put directly into the sprayer. In either case, the materials should be evenly mixed. That is, a bucket of lime water and a bucket of the bluestone solution should be run through the strainer at the same time. In order that the spray nozzles shall not become clogged with sediment later, it is necessary that the solutions be thoroughly strained. Excellent copper strainers having 18 to 20 meshes to the inch, can be found on the market.

A fairly good artificial strainer can be made by taking a small box, about a foot square, knocking out the bottom

of the same and nailing several strips of ordinary window screen over the bottom.

For actual spraying work, we have several types of bucket and knapsack machines, but these are too small and do not give sufficient pressure to be of service in spraying trees. A good vertical barrel pump sprayer is serviceable for general use in a small orchard. It is not our purpose to recommend any particular make of pump, but there are several things to be considered when buying one. First of all, it should have a large air chamber so that 75 pounds pressure can be generated. The cylinder, plunger, valves, and in fact all working parts should be of brass. The pump should also be so fixed in the barrel that it can easily be removed in case of needed repairs. For convenience in getting the pump about in the orchard it will be best to mount it on a wagon.

Two leads of hose should be attached to the pump, as one man can drive and pump while two men spray. The men can "trade off" occasionally, as pumping is very fatiguing. The one who is pumping should always endeavor to keep at least 70 pounds pressure. For spraying orchard trees, extension rods must be attached to the end of the hose. Bamboo poles with inner brass rods are used for this purpose. These rods should have brass stopcocks at the base so that the spray can easily be turned on or off as desired by the operator.

No one part of a spray machine is of greater importance than the nozzle. It is absolutely impossible to spray trees properly with the best pumps unless good nozzles are used. Good nozzles are those which give a fine spray and yet do not easily clog with sediment. However, if clogging does occur, the nozzle should be so constructed that the sediment can be easily and quickly removed.

There are several good types of nozzles on the market, such as the Vermorel, Bordeaux, and Cushman.

In spraying large orchards, where one uses power sprayers carrying 200 to 250 gallons, it means that the material must be made on a large scale. In doing this, stock solutions of both copper sulphate and lime are made. In making the ordinary copper sulphate solution, the material is dissolved in water at the rate of one pound to each gallon of water. To do this weigh out 50 pounds of bluestone, place it in a sack, and hang the sack in the top of a 50-gallon barrel which is nearly filled with water. Allow the material to remain there 12 to 20 hours to dissolve. After it has entirely dissolved, remove the sack and add enough water to fill the barrel. One should always

make his stock solutions a day or so before they will be needed, because of the time required for the copper sulphate to dissolve.

The stock solution of lime is prepared in a similar manner. Weigh out 50 pounds of lime and slack it in a barrel, using at first just enough water to slack the same. In slacking such a large amount of lime, one has to be careful and keep it vigorously stirred to prevent burning. As soon as the entire quantity of lime is well slacked, fill the barrel with water.

After the stock solutions have been prepared, the barrels should be covered so that evaporation will be lessened, unless one is intending to use the material immediately.

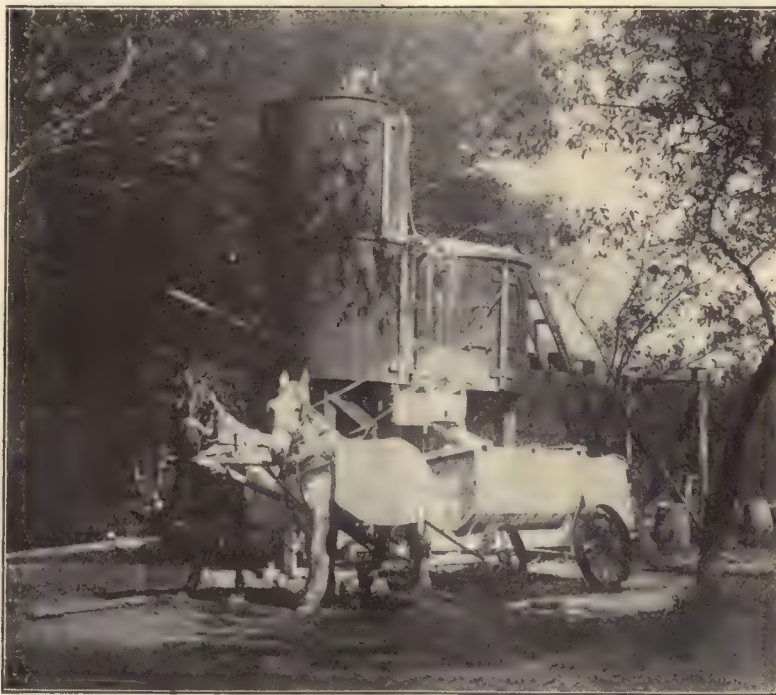


Fig. 6. Mixing apparatus in Lincoln orchard.

In case the stock solutions are kept for a long time and considerable evaporation has resulted, the amount of water evaporated from the barrels should be replaced.

Between the two stock solution barrels on an elevated platform one should have two dilution tanks. These should be rather large in diameter but not very deep (about $2\frac{1}{2} \times 6$ or 7 feet) so that it will be possible to readily stir the mixtures which are placed in them. Each tank should hold at least 150 gallons.

The elevated platform just mentioned should be large enough to accommodate the two dilution tanks, the stock solution barrels, and the men who mix the materials. This platform should be about six feet from the ground, so that the bottom part of the tanks will be a trifle above the solution tank of the spray machine when the machine is brought alongside. A trough should extend out from each dilution tank and unite to form a larger one just beyond the platform. In joining these troughs to the dilution tanks, the plan of the valves should be such as to make it possible to either partially or entirely open them at the will of the operator. Also, when the flow is shut off, the construction should be such that no leakage will result. At times considerable spray material is wasted, due to leaky valves. Back of the dilution tanks at the same or a trifle higher elevation should be a large water supply tank. A piece of 4-inch hose with a stopcock should be attached to the base of this tank, so that it will be possible, when desired, to quickly fill the dilution tanks with water.

In making the Bordeaux from these stock solutions, one should first thoroughly stir each stock solution so that the dissolved materials will be uniformly distributed throughout the mixtures. For making 200 gallons of spray, the usual amount carried in a power sprayer, take 12 gallons from each stock solution barrel, which would be the amount of stock material required for the above quantity of spray for the 3-3-50 strength. The copper sulphate solution should be placed in one dilution tank and the lime water in the other. Water should then be added until there is 100 gallons in each tank. The materials are then ready to be run through the troughs into the spray machine. As

(6 pounds of lead arsenate) is weighed out and thoroughly mixed with water in a bucket. It is then poured through the strainer as the Bordeaux is being run into the machine.

If one uses home-boiled or self-boiled lime-sulphur instead of Bordeaux, the general plan of the apparatus will be quite similar to the Bordeaux apparatus explained above.

For applying these spray materials to the trees, a gasoline power sprayer is the best machine to use. With a power sprayer giving 140 to 180 pounds pressure a fine mist spray can be attained—a thing that is necessary for best



Fig. 8. Check plat in foreground. Showing defoliated condition of trees as compared with Bordeaux plats in background. (Arlington orchard.)

results. Three leads of hose can also be attached to a power sprayer, thus making the process of spraying comparatively rapid. Where three leads of hose are used, the driver of the machine can handle the third lead. In order that he may best reach the tops of the trees and cover with spray those portions of the same that are generally missed by the persons spraying from the ground, a small elevated platform should be constructed above the spray tank.

The same types of extension rods and nozzles that were recommended for the small orchard sprayer are equally well adapted for the power machine. Good strong hose is especially necessary with the power sprayer outfit, because of the high pressure to which it is subjected. With such a high pressure machine it is also necessary to always keep on hand plenty of hose, nozzles, and fasteners in case of needed repairs.

LIME-SULPHUR AS A SUBSTITUTE FOR BORDEAUX.

While Bordeaux is probably the best all round fungicide we have at present, it has certain characteristics that sometimes make it undesirable. Some varieties of apples, for instance, are russeted so badly by it that their market value is materially decreased. Improperly mixed Bordeaux or unfavorable weather conditions often cause a burning of the foliage. With the evidence we now have regarding spray materials, it is highly probable that it is necessary to abandon Bordeaux, at least for certain varieties.

It has been known for some time that certain mixtures of lime and sulphur possess fungicidal as well as insecticidal properties. Recent demonstrations have proved that the lime-sulphur sprays have properties that warrant their use when winter treatments for San José scale are needed. As a summer spray to combat fungous troubles they have to be used in a more cautious manner. Lime-sulphur sprays may be divided into three groups: Commercial, home-made, and self-boiled lime-sulphur.

Commercial lime-sulphur as it is put on the market by



Fig. 7. Filling spray tank from a stream by means of a rotary pump.

they are run out, the lime stock should be kept well stirred to prevent settling. It should also pass through a copper strainer that has a fine mesh, before it enters the spray tank. Where an insecticide is used in the spraying, the amount of the poison needed for 200 gallons of spray

several firms is in the form of an orange-red solution. It is the product of these two substances after they have been boiled together until they go into solution. The products of different firms vary in degree of concentration and there may be a wide range of variation in this respect in the product of a given firm.

Home-made lime-sulphur is similar to the commercial, though not so concentrated. If properly made, it may be used as a summer spray for apples, though its chief use has been as a winter wash for San José scale.

In connection with the spraying demonstrations of 1909 and 1910 tests were carried on to see how apple scab could be best controlled without russetting the fruit or burning the foliage. To determine this, Bordeaux, Commercial (Rex), and self-boiled lime-sulphur were employed. Different strengths were used. Certain plats had Bordeaux through the season; others had the fungicide omitted the second spraying, and still others had lime-sulphur either for the second spraying or through the season. The scab results for 1909 were somewhat contradictory. These tests were repeated in 1910, but no scab developed even on the unsprayed plats. A representative tree was picked from each plat and the fruits sorted for russet. Two grades were made. Those showing no injury and those showing it slightly but not enough to injure their sale were put into one grade, and those with russet enough to injure the market value into the other.

Results of the use of Bordeaux alone and in combination with lime-sulphur in russetting Ben Davis apples.

Spray mixture used.		Badly russeted.		Free or only slightly russeted.	
First spraying.	Second spraying.	No. of apples	Per cent.	No. of apples.	Per cent.
4-4-50 Bordeaux.	3-9-50 Bordeaux ..	105	31.8	228	68.2
Omitted	3-3-50 Bordeaux ..	55	9.0	550	91.0
4-4-50 Bordeaux.	3-3-50 Bordeaux ..	116	15.3	635	84.7
4-4-50 Bordeaux.	4-4-50 Bordeaux ..	66	17.5	310	82.5
4-4-50 Bordeaux.	Omitted	56	2.9	1874	97.1
4-4-50 Bordeaux.	1½-50 Rex	100	6.8	1361	93.2
1½-50 Rex.....	1½-50 Rex	13	1.4	866	98.6
4-4-50 Bordeaux.	10-10-50 Self boiled.	40	4.3	882	95.7

The results from this table indicate plainly that it is the second spraying that causes russetting. The lime-sulphur sprays do not russet the fruit—the small per cent noted in the table is probably due to the Bordeaux from adjacent plats. No serious leaf injury resulted from any of the mixtures. In the Columbus orchard, 1910, the self-boiled lime-sulphur plat seemed to have brighter foliage than either the Bordeaux or the Rex plats. No injurious effect has ever resulted from using arsenate of lead in combination with the lime-sulphur sprays.

RECOMMENDATIONS.

1. Do not wait until spraying time to begin making preparations. Plan mixing devices and be provided with all the necessary materials and the spray machine well in advance of the spraying season.

2. Properly constructed mixing devices are very essential for rapid and efficient work.

3. The first spraying for apples should be made with 3-3-50 Bordeaux, 1½-50 commercial lime-sulphur, or 10-10-50 self-boiled lime-sulphur just before the individual flower buds open. No poison.

4. The second spraying is the most important one and it should be applied after the flowers have begun to drop and before the calyx lobes close. For such varieties as Ben Davis and Gano that are easily russeted, use one of the lime-sulphur sprays. Use either Paris green at the rate of ½ pound to 50 gallons or lead arsenate at the rate of 1½ pounds to 50 gallons in combination with the fungicide. Thoroughness and high pressure are very essential.

5. The third spraying should be made with the combination fungicide and poison about three weeks after the second.

6. The fourth application should be made with the poison alone about seven weeks after the third. (A fifth application, consisting of poison alone, some time in August, is to be recommended in orchards where the skeletonizing caterpillars are troublesome.)

7. Self-boiled lime-sulphur 10-10-50 will control mild cases of apple scab, and it will not burn the foliage or russet the fruit.

8. Commercial lime-sulphur can be used as a summer spray for apples with as little danger to the foliage as Bordeaux. It does not russet the fruit enough to injure its market value.

SOILS AND SOIL MOISTURE.*

Prof. Childers.

In dealing with soil moisture it would be well to consider the rise of soil moisture.

Clay soils are nearly always wet. Sandy soils are always dry. Clay soils will lift water from greater depths because of fine particles in the soil.

Size of sand runs from .025 of an inch up to coarse gravel. Clay particles are more than 5-1,000th of an inch in diameter.

Owing to the density of particles in sand, there is space between the molecules which fills up with water, and the gravity of the water tends to pull it down instead of up, and that is the reason why sandy soils dry out and require more water.

It is the root hair on the plant which takes up the water.

Plants take water from sandy soils much more easily than from clay soils.

Adding manure to clay ground will transmit conditions of water in sandy soil.

The fertility of a clay soil will outlast the fertility of a sandy soil, but that should not excite us when water is the main feature.

If you grow alfalfa be sure to incorporate some organic matter.

Nitrogen does not exist in soil particles.

You will find a film of water about each soil particle, full of bacteria, and they will not grow unless they can get air.

Our soils are sandy compared with eastern soils.

Our sand is quartz and our clay is feldspar.

Black alkali is sodium carbonate.

You will never find pure water in a soil.

Water flowing through a soil which is charged with any kind of alkali, whether magnesium or lime, will make the water denser, and when the water on the outside of the plant cell is nearly to the density of the water inside the plant cell, this causes alkali.

Phosphorus in a soil is in the form of calcium phosphate, is insoluble and therefore cannot be washed out of a soil, so you need not fear about phosphorus being washed out if alkali needs to be washed out.

The nitrogen of a soil is united with its humus and you cannot wash humus out, but if that soil is aerated and that humus breaks down and dissolves, then nitrogen will go into solution and wash some of it out, but this need not worry us.

If excessive evaporation can be shut off outward, this reduces rank growth of crops and tends to keep out alkali.

Hardpan does not necessarily have to be clay or cement. Any substance which forms a barrier to the sinkage of water is termed hardpan.

Whenever you find a clay coming in contact with lime it ceases to be flattened out, but crumbles it up, and under those conditions you will find hardpan.

With hardpan formed with clay, subsoil to bring it up to the surface of the soil. Take a plow and turn over the top 6 inches, then take a subsoiling plow to break up the hardpan.

When trees are planted in a shallow soil they are going to be short-lived.

If you can keep ground fertile and plants well cultivated to produce heavy growth, there will be less danger in frost.

When rainfall is under 15 inches, dry farming is a hazardous business.

Plants cannot take all the water from the soil.

Sandy loam soil will weigh about 95 pounds per cubic foot.

One pound of sandy loam soil particles will have 816 square feet of surface and will give up all of its water excepting 8 per cent.

Silt loams contain 1,340 square feet of particles and will give up all of its water excepting 25 per cent.

Clay soil contains 2,000 square feet of particles and 40 per cent of its water will be available.

The following table shows the amount of water required per ton of dry matter:

*From Bulletin No. 1, Movable Schools of Agriculture, University of Idaho.

Beans, 260 tons; peas, 447 tons; corn, 272 tons; clover, 453 tons; wheat, 359 tons; sunflower, 490 tons; rye, 377 tons; oats, 557 tons; barley, 393 tons; buckwheat, 664 tons; millet, 416 tons; mustard, 843 tons; potatoes, 423 tons; rape, 912 tons.

An acre inch of water equals 115 tons of water.

Get ground just as open in the fall as you can, then if you can break ground up and leave it just as rough as possible, any sun or water coming down will get down, and as early in the spring as possible cultivate to stop evaporation, then get in and plant whatever you are going to plant. If your crop is to mature near July when the sun is out the hottest, something is going to burn up, because evaporation goes on too rapidly. The grain will ripen before it is filled. Get grain in early and crop off early.

THE DANGER OF USING FOREIGN POTATOES FOR SEED.*

Large quantities of European potatoes are at the present time being received into this country. Their fine appearance and reasonable cost in comparison with the high cost of home-grown seed have led growers to consider the advisability of using them for seed in place of home-grown stock. This should under no circumstances be done.

A wide experience in testing a large number of foreign-grown varieties has demonstrated that, with few exceptions, foreign stock is not adapted to the climate and soil conditions obtaining in this country. The Department of Agriculture during the past seven years has tested more than 100 foreign varieties, with the uniform result that the yields during the first year were not equal to the yields of our best American sorts. These results have been repeatedly corroborated by American growers and seedsmen. The few fairly satisfactory varieties of the many tested have required from two to three seasons to become acclimated.

The varieties of potatoes which are now being imported into this country consist of late-maturing sorts and in consequence are not adapted for early crop production. For this reason these potatoes should be avoided by southern planters.

Experience has also shown that the standard "main-crop" varieties grown in the British Isles, as well as on the Continent, set a large number of tubers, much larger, in fact, than our American varieties. As a result of this tendency these varieties require an unusually fertile soil and especially favorable climatic conditions to develop their tubers to a merchantable size. As a rule our soils are not sufficiently well supplied with organic matter, available plant food, and moisture to produce satisfactory crops with these varieties. There is also great danger of introducing several new diseases of potatoes which occur abroad, but which are as yet unknown here.

The most dreaded of these is the wart disease, concerning which so much has been written in England and in this country. Potato wart, or "black-scab," is a disease of the tubers which forms large, irregular excrescences, at first greenish or white and later black. These begin near the eyes, but in advanced cases involve the whole tuber, which is converted into an unrecognizable and useless mass. There are no conspicuous evidences of this malady in the foliage of affected plants. The more severe cases exhibit the disease at the surface of the ground, where the worst affected tubers protrude above the soil. Other tubers have small warts, but are usable for culinary purposes, and some may be so slightly affected as to pass as healthy. It is a disease difficult to detect by inspection in its early stages, and there is nothing to prevent its distribution in the United States on imported potatoes. This danger is the greater since the badly infected districts of England lie near Liverpool, from whence many shipments are made. This disease has been more fully described in two publications of the Department of Agriculture, Circular No. 52 of the Bureau of Plant Industry and Farmers' Bulletin 489, both of which may be had free of charge upon application to the Secretary of Agriculture or to a Senator, Representative or Delegate in Congress.

Such dangers as the present emphasize the need for a national quarantine law to enable the Secretary of Agriculture to exclude diseased or insect-infested plant products or imports from localities known to have these pests. Such a bill has been pending before Congress for several years, but as yet no action has been taken.

The potato wart is not the only disease likely to be imported. There is another tuber trouble, known as Spongospora scab [*Spongospora subterranea* (Wallroth) Johns.], which would be an undesirable addition to our already long list of diseases brought from foreign sources. This scab causes small spots or even tumor-like growths of small size. It does not destroy the potato, as may the wart, but lessens its market value. Spongospora scab is quite prevalent in Ireland. Large quantities of potatoes are now being imported from that island.

A third trouble which may be introduced on imported potatoes is the black-leg, a bacterial disease which can rarely be detected in the tubers, as the infection is always internal. It manifests itself in the field after the potatoes are half grown. The tops yellow and curl up, the stem blackens and decays at the base, and the hill dies. This disease has already been introduced into many of our States, probably from England by way of Canada. The danger is no less in importations from Germany, as the disease exists there as well as in England.

The wart disease also exists in Germany, but there is less danger of its importation from that country, as it is not yet common in the principal potato-producing sections there. German potatoes may, however, be affected by "leaf-curl," a peculiar disease of doubtful nature very widely prevalent in that country. This disease causes a curling of the leaves and reduces the yield or cuts it off altogether. It is transmitted in the seed tubers, but is not to be detected by any kind of inspection.

The danger from these diseases is not limited to a single season, as soils once infected remain unfit for potato culture for many years.

These facts, together with those previously presented concerning European varieties of potatoes, should become generally known in time to prevent the planting of such foreign seed.

Any diseased or doubtful specimens discovered should be sent to the Department of Agriculture for identification.

OKLAHOMA'S IRRIGATION STATISTICS.

The total number of farms irrigated in 1909 was 137, against 124 in 1899, an increase of 13, or 10.5 per cent. Within the same period the number of farms in the state increased 75.4 per cent. On many of the farms reported irrigated only small gardens were watered.

The total acreage irrigated in 1909 was 5,402 acres, against 2,759 acres in 1899, an increase of 2,643 acres, or 95.8 per cent. During the same period the improved acreage on farms increased 104.1 per cent, indicating a very slight decrease in the percentage of improved land irrigated. The percentage is but 0.03 in either year, showing that irrigation is a very unimportant factor in Oklahoma agriculture.

The total acreage which all enterprises were capable of irrigating in 1910 was 7,411, an excess of 2,009 acres over the area irrigated in 1909. The area included in projects now completed or under construction is 9,442, an excess of 4,040 acres over the area irrigated in 1909.

The number of independent enterprises reported in 1909 was 114, against 119 in 1899, a decrease of 4.2 per cent. The length of main ditch in 1909 was 54 miles, against 68 in 1899, a decrease of 20.6 per cent. In view of the increase in the area irrigated, it is probable that these decreases are due to differences in enumeration rather than to actual decreases in the number of enterprises and length of ditches. The number of reservoirs reported is 11, with a combined capacity of 22 acre-feet. The number of wells pumped for irrigation was 65, and the acreage irrigated with pumped water is 119, or slightly less than 2 acres per well.

The total cost of irrigation systems reported for 1910 was \$45,200, against \$19,672, an increase of \$25,528, or 129.8 per cent. The average cost per acre in 1910 was \$6.10, against \$7.13 in 1899, a decrease of 14.4 per cent. The

*Abstract of Circular 93, Bureau of Plant Industry, Department of Agriculture.

average annual cost of operation and maintenance per acre in 1909 was 51 cents.

No irrigation enterprises in the state are operating under the Federal reclamation act (act of June 17, 1902), the Carey Act (act of congress August 18, 1894), or irrigation district laws. Co-operative enterprises supplied water to 2,000 acres. The remaining 3,402 acres were supplied by individual and partnership enterprises. Streams supplied 5,269 acres, or 97.5 per cent of the total area irrigated. Of the remaining acreage, lakes supplied 28 acres, wells 69 acres, springs 16 acres and reservoirs 20 acres.

EVERLASTING WATERING TANKS.

Many farmers and stockmen want to know how to build their own concrete watering tanks and troughs. The method is easy and a tank is not expensive. To explain the plan, a horse and cattle tank is described below which holds 30 barrels of 31½ gallons each. If desired, smaller or larger troughs, round or square, may be built in exactly the same manner. Such tanks, well made, never crack, wear out or cause mudholes.

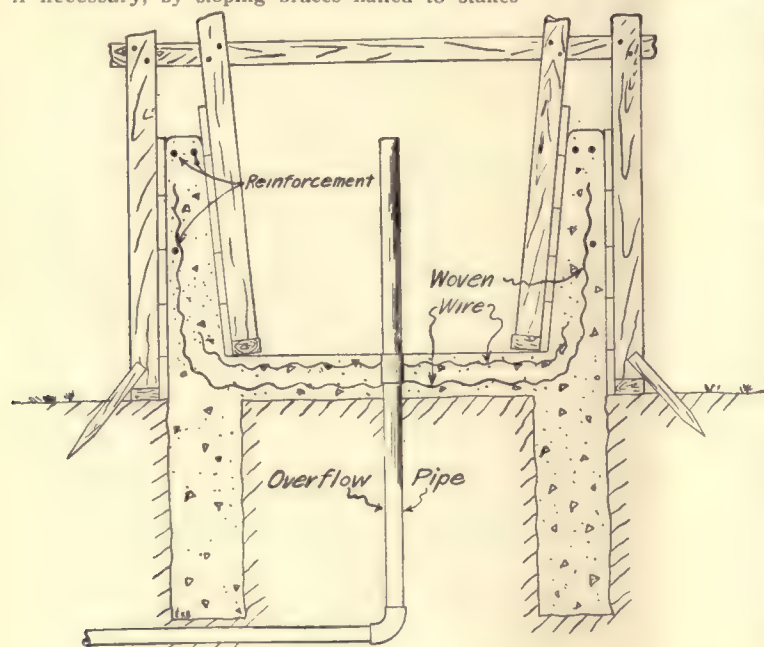
To build an oblong tank like the one shown in the picture, mark out the ground plan 5 by 14 feet. Within these lines scrape away all trash and dig a foundation trench 10 inches wide and 2½ feet deep around the entire tank. Lay all inflow and overflow pipes (not less than 1½ inches in diameter) so that the ends, fitted for connections, will be even with the finished bottom of the tank.

Before digging the foundation trench, build the forms and have all materials on hand. For forms use 1-inch siding on 2x4-inch uprights spaced 2 feet apart. The outside form is a bottomless box 5 feet wide by 14 feet long, inside measurements. Make it 3 feet high to provide for a 6-inch floor and a clear depth of 2½ feet. The inside form must be narrower and shorter to make provisions for walls 5 inches thick at top and flaring to a thickness of eight inches at the bottom of the tank. When ice forms, this slope allows it to slip up the tank walls instead of pushing directly against them. The sides and ends of the forms may be made separate and put together in place; or, if there is sufficient help, each form may be entirely completed and set up as one piece. The forms are held in position by 2x4-inch liners at top and bottom and, if necessary, by sloping braces nailed to stakes

driven in the ground. Cut strips of heavy woven wire fencing long enough to cover the bottom of the tank crosswise and to project up into the walls to within 6 inches of the top, and likewise a strip 4 feet longer than the inside length of the tank.

With the forms ready, mix the concrete 1 part Portland cement to 2 parts sand to 4 parts crushed rock. In measuring the materials, count 1 bag of cement equal to 1 cubic foot. If bank-run gravel is used, mix the concrete 1 part cement to 4 parts gravel. Fill the foundation trench with concrete. Set the outside form in place. See that it is level, so that the tank will be level and can be entirely filled with water. Lay the 6-inch bottom reinforced 1½ inches from the under side with the short lengths of woven wire crosswise and 1½ inches from the upper side with the long strip of fencing. Bring up the extra length of wire so that the ends will project up into the future side-walls and can be fastened to the reinforcing rods. (This wire reinforcing in the bottom will prevent possible cracking due to heaving by frost.) Finish the surface of the bottom the same as for a sidewalk. Do not let concrete get into the inflow and overflow pipes.

With the bottom finished, immediately set the inside form in place and fill the wall space with concrete mushy wet. Half-way up the side, and 1 inch from the outside, lay a ¾-inch rod (or several hooked together) entirely



around the tank. Again 2 inches from the top and 1 inch from both inside and outside, imbed two more ¾-inch rods in the concrete. Round the top edges of the tank with a trowel or a sidewalk tool. If a tank cover is desired, insert ½-inch bolts, heads down, in the soft concrete with sufficient length above the top of the wall to pass through the wooden cover and to receive a nut and washer.

When the tank is three days old, remove the inner form and paint the inside of the tank with a mixture of cement and water as thick as cream. Screw into the overflow connection the necessary length of overflow pipe. The tank may be used in ten days provided the outside form is left in place. If the outer form is removed at the same time as the inner, do not use the tank for two weeks.

BILL OF MATERIALS.

Crushed rock, 6½ cu. yds., at \$1.10.....	\$ 7.15
Sand, 3¼ cu. yds., at \$1.00.....	3.25
Portland cement, 10½ barrels, at \$2.50.....	26.25
12 rods, ¾ in. by 10 ft., 45 lbs., at 2¼c.....	1.00

Total\$37.65

By getting prices from local dealers, the cost may be found to be less. Such a tank is by far the cheapest to be had, since it never needs repairs and never wears out.

IRRIGATING LAND FOR THE PRODUCTION OF FLAX SEED.*

BY H. L. BOLLEY.

We receive many letters asking regarding the advisability of putting flax into wheat or barley or oats stubble and as to the advisability of putting flax on corn lands of the previous year.

Flax After Corn: With regard to this topic there can be not the slightest question as to the results. On my own experimental plots I have, in a small way, demonstrated that a properly cultivated corn ground is the best preparation for flax crop, provided the cultivation has been sufficiently thorough and persistent during the corn growing season to keep down the weeds and mature a good corn crop. If the land were properly deep plowed for the corn it should not be replowed for flax, but should be levelled in any manner in which the corn rows can be smoothed over, so as to get the ground evenly level. Discing, planking, packing and harrowing on the surface of such old corn ground, provided the discing and harrowing are done when the ground is sufficiently damp not to cause it to blow, will prepare a seed bed for flax which has no equal.

Flax After Wheat, Oats or Barley: If the ground were properly plowed previous to the wheat, oats or barley, and the ground is reasonably free from weeds, a thorough discing and harrowing and packing of such stubble lands will give a good seed bed for flax. When I write this I mean, however, that the discing, harrowing and packing should be thorough, and that the discing, harrowing and packing should be done while the ground is damp, so that it will work down in good shape. No effort should be made to get the ground loose. If, however, the crop is being planted in this manner in a region where Russian thistle, tumbling mustard and other weeds have blown over the land during the year, I do not believe it is advisable to prepare the seed bed in this manner unless it is in the southern portion of the state, when it will be possible to harrow and disc and pack such land several times during the spring before it is time to seed the flax, allowing the weed seeds to germinate, after which the flax should be planted immediately after the last working of the ground, while the ground is fresh and moist.

Planting Flax on Weedy Stubble Land: In this case the land should be plowed deep, so as to turn under the stubble and weeds of the last year to a considerable depth—say five to seven inches or better. The plowing should be done when it is time to plant flax, and a sub-surface packer should follow the plow at once while the plowing is being done. This should again be followed by a cogwheel packer or some heavy surface packer, then the flax drilled in while the ground is fresh and moist. Following the drill it will not be a bad plan to put on a heavy stone boat or float to mash down the ground, or to repack the ground. On such ground too much packing cannot be done, unless it is done while the ground is muddy. The ground should be packed so hard before the drill is put on it that the discs will not cut much deeper into it than they would into new plowed sod land. The seed in no case should be planted deeper than an inch—three-quarters of an inch is still better, if the ground is packed hard enough to bring the moisture up to that point.

Do not forget to plant bright colored flax seed. Do not forget to treat all seed before planting. Do not sow over twelve quarts of good seed per acre.

Cereals After Flax on the Previous Year's Breaking: We get hundreds of letters asking us what to do with the ground on which flax grew on first year breaking. Most of the people want to sow flax on it again because they say they cannot plow the land well for other crops.

I have had during the past year a number of farmers help me in carrying out a test of the question whether such flax stubble lands where the flax grew upon new breaking can be successfully used for the growth of wheat, barley or oats, without plowing. The reason for wanting to do this rests in the fact that in a dry year the sod of the breaking on which the flax grew does not properly root. It is almost impossible to plow such land and make a success of the plowing sufficient to allow one to work down a compact seed bed. Backsetting cannot be done on such land by any other tool than a deep tilling disc plow, and even that will have difficulty to prevent the ground from being very lumpy and loose.

We have had reports from enough farmers who have tried planting wheat after flax on last year's breaking to show conclusively that such flax stubble land can be made into a good seed bed for wheat. Indeed it seems to produce a wheat crop second only to that which can be produced on a proper summer fallow or on corn lands. When I say this, remember that I mean thorough discing and pulverizing associated with thorough harrowing and packing, using some such tool as the cogwheel, corrugated, or sub-surface packer. As soon as the land thaws enough to put on a disc and cut the old sods of the flax stubble, disc the land first lengthways, then diagonally, then crossways. Then put on your packing tools and follow immediately with the drill. In the case of barley the work can be continued somewhat more thoroughly and the seed put in a little later. Remember that in planting barley to be sold for brewing purposes the object is to get a high quality of barley free from weed seeds and of high germinating power. This sort of land will give this very crop, if properly handled. To give a high malting value the barley should be harvested as soon as ripe and threshed as soon as dry. Oats do equally well under these conditions. I dislike to advocate discing in grain upon stubble because many people think that discing in grain means to run a disc once or twice over such stubble lands. If that is what the reader has in mind, my advice is, do not try to do work. To do a good job of planting wheat, oats or barley on flax stubble or to do a good job of planting flax on wheat, oats or barley stubble one should do about as much work with the disc, the harrow and the heavy packer as he would do if he should plow the land. It is just a better way of handling stubble land. It allows one to prepare a firm seed bed in the spring without getting it too loose. If, however, the work is carelessly done it will result in a good weed patch.

Irrigating Land for the Production of Flax Seed: We have considerable correspondence from various sources regarding the proper method of cropping flax on irrigated lands.

If irrigation is used it should be used with the point in view of forcing the early growth of the flax crop up to the point of boll formation, and there should be enough moisture remaining in the sub-soil at this time to properly ripen the seed and no more. The application of water will therefore depend largely upon two features, the nature of the sub-soil and the climatic conditions as affected by rainfall and atmospheric moisture. The writer is of the opinion that the land should be thoroughly flooded late in the fall just before freezing weather sets in, thus allowing the sub-soil to be thoroughly saturated. In regions where there are rains in July and August, no more moisture will be necessary.

In some regions a spring flooding, or perhaps two, may be necessary, one before the seed is planted and one just preceding the blossom period. If irrigated after it is in blossom it is apt to continue blossoming, and it will be difficult to get it to ripen. This is especially true if the crop is late or if there are cool nights in the region under consideration. A clear sky and soil which tends to become drouthy at maturing time seems to be essential for the production of flax seed of high quality.

THINGS WHICH HURT THIS COUNTRY.

The government made a great mistake in irrigating the upper Pecos valley in New Mexico through its Hondo project. After the appropriation had been made to construct a great reservoir at that place the land sharks immediately began to sell the land which was assumed would be watered from the dear old reservoir which Uncle Sam was to build for them. All kinds of people flocked in and purchased this land at fancy prices. Now it turns out that after the reservoir was constructed twice there is no water because it is mostly lost through seepage. The wind has carried considerable sand into the reservoir which absorbs what little water is left. It was one of the most beautiful bunco games ever perpetrated on the American people and the funny part of it all is that not a newspaper in the country has mentioned it. The thing that has occurred at the Hondo has practically found a replica at every other reclamation project that Newell has undertaken and the joke keeps running on like the water in the brook, only in this case the joke is dry.—*The Denver Field and Farm.*

(*Abstract from Press Bulletin No. 47, North Dakota Experiment Station).

THE PRIMER OF HYDRAULICS*

By FREDERICK A. SMITH, C. E.

10. Trapezoidal ditch, 2 ft. base, slope 2 to 1, grade 1 in 1,600, $n = .025$, $s = .00062$. (Fig. 103.)

Depth.	Area.	W.P.	r .	\sqrt{r} .	C .	v .	Cfs.	Gals. per min.
2'	12.0	11.0	1.01	1.0	56	1.4	16.80	7,539
4'	40.0	20.0	2.00	1.4	65	2.27	91.00	40,840
6'	84.0	29.0	2.87	1.7	70	3.01	253.26	113,612
8'	144.0	38.0	3.75	1.9	73	3.51	506.16	227,150
10'	220.0	47.0	4.64	2.1	76	3.99	877.80	393,957
12'	312.0	56.0	5.58	2.3	78	4.48	1399.32	628,014
14'	420.0	65.0	6.46	2.5	81	5.06	2125.20	975,289

11. Trapezoidal ditch, base 3 ft., slope 1 in 1, grade 1 in 400, $n = .025$, $s = .0025$. (Fig. 101.)

Depth.	Area.	W.P.	r .	\sqrt{r} .	C .	v .	Cfs.	Gals. per min.
2'	10.0	8.6	1.16	1.1	57	3.13	31.30	14,044
4'	28.0	14.2	1.97	1.4	65	4.55	127.40	57,177
6'	54.0	19.8	2.77	1.7	71	6.03	325.62	146,138
8'	88.0	25.4	3.47	1.9	74	7.03	618.64	277,645

12. Trapezoidal ditch, base 10 ft., slope 1 to 1, grade 1 in 1,600, $n = .025$, $s = .00062$. (Fig. 101.)

Depth.	Area.	W.P.	r .	\sqrt{r} .	C .	v .	Cfs.	Gals. per min.
2'	24.0	15.6	1.54	1.2	61	1.83	43.92	19,711
4'	56.0	21.2	2.65	1.6	69	2.76	154.56	69,366
6'	96.0	26.8	3.57	1.8	72	3.24	311.04	139,577
8'	144.0	32.4	4.45	2.1	75	3.75	540.00	242,352
10'	200.0	38.0	5.26	2.3	78	4.48	897.00	402,573
12'	264.0	40.8	6.47	2.5	81	5.06	1335.84	559,525

13. Advantage of Lined Ditches.

When conducting water through ditches many things must be considered, such as the maximum and minimum flow to be expected and the resulting velocities. Small flows of moderate velocities can be accommodated by any ditch cut into the natural soil so long as the mean velocity remains below 2 ft. per second. But as the velocity grows, which is always a natural consequence of increased volume, there appears the danger of erosion or the water cutting into the wetted surface of the ditch. Hence in designing a ditch the maximum quantity of water to be dealt with must be carefully determined and also the maximum velocity; if it is found that such maximum velocity would cause the cutting away of the bed in the ditch then it will be better to line the ditch with masonry, brick, concrete, lumber, metal, etc. In adopting this course the coefficient of roughness n is greatly reduced according to the material used, which increases the factor C in proportion so that the dimensions of the ditch may be decreased, or else the slope made smaller, which results in a saving in the required head. Thus an irrigation ditch, for instance, lined with concrete will be able to stand a velocity of 6 ft. per second without injury, while a plain ditch cut through the soil would fail with a current of 2 ft. per second or more. Another advantage of the lined ditch is that there are no losses due to seepage and the loss due to evaporation is much smaller than in the rough ditch.

As the scouring takes place in the bottom of the ditch or water course, the bottom velocity, or the velocity along the wetted perimeter, must be considered, not the mean velocity which is greater than the bottom velocity. By many experiments made for this purpose Kutter found that the bottom velocity is equal to the mean velocity divided by 1.31; thus if $v = 2.0$ ft. per second the velocity on the bottom and sides of the ditch is $2 \div 1.31 = 1.527$ ft. It is the bottom velocities which must be considered in finding the limiting value of velocities permissible in a water course cut in soil.

The following table shows velocities just necessary to move the various substances lying loose on the bed:

	Mean Velocity	Bottom Velocity
Mud and fine clay.....	0.33 fs.	0.25 fs.
Fine sand.....	0.46 fs.	0.35 fs.
Clay loam and sand.....	0.66 fs.	0.50 fs.
Common river sand.....	0.92 fs.	0.70 fs.
Gravel.....	2.62 fs.	2.00 fs.
Pebbles, 1 in. in diameter.....	2.79 fs.	2.13 fs.
Coarse gravel.....	3.93 fs.	3.00 fs.
Angular broken stone.....	5.24 fs.	4.00 fs.
Soft slate, shingle stone.....	6.55 fs.	5.00 fs.
Stratified rock.....	7.86 fs.	6.00 fs.
Hard rock.....	13.12 fs.	10.00 fs.

It is seen from this table that it requires but a moderate velocity to move such loose particles as clay or loam, whereas a ditch lined with concrete, for instance, can withstand a bottom velocity of 6 ft. per second or a mean velocity of 7.86 ft. per second.

The above velocities are just sufficient to move particles as indicated. The resistance of soils to erosion is greater as the cohesion in the material has to be overcome; the limiting velocities as to erosion are as follows:

	Feet per Second
Channel in pure sand, bottom velocity.....	1.1
Channel in sandy soil, 15% clay.....	1.2
Channel in sandy loam, 40% clay.....	1.8
Channel in loamy soil, 65% clay.....	3.0
Channel in clay loam, 85% clay.....	4.8
Channel in soil clay, 95% clay.....	6.2
Channel in pure clay, 100% clay.....	7.2

It is, however, not good policy to permit velocities as high as these unless the water is perfectly clear, since particles in suspension, such as grains of sand and gravel will cut into the walls of the channels.

14. Flumes.

Flumes may be considered lined ditches and as such what has been said about ditches applies also to flumes. The essentials of a flume is its form and the material of which it is built, which determines the factor of roughness, the hydraulic radius and the slope. In the building of open flumes it is important to plan the whole work so that the inclination of the slope of the flume is on the same angle as the average hydraulic grade line, taking a mean between high and low water stages. In many irrigation projects it is important to use the smallest slope possible in order to increase the acreage available for irrigation. In order to do this and at the same time to obtain the largest amount of water practicable it is essential to build a flume in which the coefficient of roughness is as small as possible consistent with good economic practice.

For instance, let it be required to design a flume capable of carrying 40 second feet of water a distance of three miles on a grade of 18 in. per mile.

Analysis.—Let the size of the flume be 3 ft. by 4 ft. and the flow area be $3 \times 4 = 12$ sq. ft. when delivering 40 second feet: then $v = 40 \div 12 = 3.333$ fps.; then, according to the fundamental formula: $v = C \sqrt{rs}$, we know all the quantities except C , hence by transposition:

$$C^2 = v^2/rs \text{ or } C = v\sqrt{r/s}.$$

$$\text{The hydraulic radius is } 12 \div 10 = 1.2 \text{ and } \sqrt{r} = 1.09.$$

Substitute given quantities and make computations:

$C = \sqrt{3.333^2/1.2 \times .00028} = \sqrt{11.11/.000336} = \sqrt{33065} = 181.8$. Hence the factor C is 182 for a hydraulic radius of 1.2 and sine of slope of .0003, which indicates by consulting Tables A and I that the coefficient n must lie between .008 and .009, which means that the flume requires to be almost perfect, and as a consequence it would be cheaper to either enlarge the flume or increase the sine of the slope. As a usual thing this latter alternative is not practicable, so the size of the flume must be increased to reduce the velocity. By making the size of the flume 4x4 gives a flow area of 16 ft.; divide this into 40 gives $v = 2.5$; the hydraulic radius is $16 \div 12 = 1.33$; $\sqrt{r} = 1.16$ and $s = .00028$, and by substituting values in the formula: $C = v\sqrt{r/s}$ we obtain:

$$C = \sqrt{6.25/1.33 \times .00028} = \sqrt{16756} = 129.4.$$

This value of C is considerably lower, and looking in

Table IV it is seen that the coefficient $n = .012$ would be fitting the construction of the flume, as a slope of .0004 and a hydraulic radius of 1.0 gives $C = 126$, and for a hydraulic radius of 1.44 $C = 134.29$. Then consult Article X for the selection of construction material.

Should it be possible to increase the slope to say .0004 the size of the flume might be decreased and the size 3 ft. by 4 ft. will give good results as $C = \sqrt{3.333^2 / 1.2 \times .0004} = \sqrt{11.11 / .00048} = \sqrt{23145.8} = 152.1$. By consulting Tables II and III it is seen that the factor n lies between .010 and .011, somewhat nearer to .010, which is a guide for the selection of flume material as indicated in Article X.

It is necessary to use good judgment in the planning of hydraulic problems and it is much better to make trial plans and computations for all possible conditions and then select the best, than to find after the work is done that it is not satisfactory.

A VERY SATISFACTORY MACHINE.

As our readers already know, we are printing this paper for their best interests and if we find something exceptionally good, we want to call their attention to it.

Perhaps some of you have noticed the advertisements



of a new sharpening machine which the Luther Grinder Mfg. Co., Milwaukee, have recently placed on the market and are selling at exceptionally low prices for the present. This proposition so appealed to the editor that he made up his mind to look into it. Accordingly he ordered one of the above outfits. The machine has so far exceeded expectations that he can not help mentioning it in this issue. Although Mr. Luther makes some pretty strong claims as to the merits of the machine, they are more than justified, and any one using tools is certainly carrying on his work under a disadvantage without its help. This is as far ahead of the grindstone as the modern binder is ahead of the old-fashioned cradle. We could not believe that a sharpening stone would ever be manufactured which would be as far ahead of the grindstone, but the new Dimo-Grit wheels are certainly better than anything we have ever heard of. The cutting and sharpening qualities are such that no one can believe what they will do unless he has actually seen the wheels at work.

Mr. Luther guarantees grinders to stand up under hard usage for at least five years. The company wrote us that they would gladly send one of their large and interesting books to any reader who would drop them a line. The machines will be sent on free trial if you so desire.

We were afraid that the grinding wheels would draw the temper of fine tools, but there is absolutely no danger whatever on that score. We admit it seems hard to believe, but such is the case. The only thing that would make you believe it is to do the way we did and try one of these outfits yourself.

SOME FACTS WORTH KNOWING REGARDING THE INTERNATIONAL HARVESTER CO.

The International Harvester case differs radically in its facts from all the so-called "trust" cases heretofore decided under the Sherman Law. The International Harvester Company was organized in 1902 for the purpose of securing economy in the manufacture and sale of harvesting machinery, and of increasing the foreign trade. It had no water in its capitalization, and it has earned only a reasonable return on its capital—less than seven per cent per annum on the average. The prices of its machines are now substantially the same as in 1902, notwithstanding an increase of 15 per cent in raw material prices and 30 per cent in wages. The company has caused a large saving to American farmers in the cost of agricultural implements. It has increased the foreign trade in agricultural implements fourfold in nine years; its foreign sales in 1911 were over \$42,000,000. It has not sold cheaper abroad than at home. Its treatment of its customers, its employees, its agents and its competitors has been in accord with the highest standard of ethics and honorable business methods. To the farmer it has given better service and better machines; to agents and dealers, a less hazardous and fluctuating business; and to its employees it has given higher wages, improved and sanitary working conditions, insurance against sickness, accident and old age, and a share in the profits.

The charges of misconduct found in the bill have been met and disproved by the company in other cases; and they will again fail, because they are untrue. The supreme court of Missouri, in a suit in which these charges were fully gone into, said:

"On the whole, the evidence shows that the International Harvester Company has not used its power to oppress or injure the farmers who are its customers."

And again:

"The price of harvesting machines has not increased in proportion to the increased cost of construction or the increased merit of the machines, and respondent has brought other farm implements into trade."

"The evidence also shows that the machines manufactured by the International Harvester Company have been greatly improved in quality and the item of repair material has been reduced in price and placed within closer reach of the farmer."

The organizers of this company acted under the advice of able counsel, and in the sincere belief that they were violating no law. If under later decisions it should be held that the law was violated, it could only be through the creation of a power to oppress which has ever been exercised.

More than six years ago the company asked for its investigation by the United States government, and opened all its books and records for inspection, and furnished all information requested. No suggestion of any change in its business methods has been made to it by the government at any time. Recently, a full and frank discussion of the whole situation has been had between the representatives of the government and the company, in an honest desire upon both sides to avoid litigation. Some plan may yet be found which will obviate the necessity of any protracted litigation by satisfying the claims made under the Sherman Act, without seriously impairing the economic advantages and benefits secured by the organization of this company. No form of reorganization, however, was suggested by the government which seemed practically possible.

The government has been careful to avoid embarrassment to the foreign business from the litigation; the bill makes no attack upon, and seeks no change in, the export business of the company. The filing of the bill will in no way interfere with the company's carrying on its business the same as heretofore.

DO NOT NEGLECT TO BUY THIS BOOK.

The Primer of Hydraulics is now ready and can be obtained, clothbound, by sending \$2.50 to THE IRRIGATION AGE. Is the best and plainest book ever gotten out on hydraulics and is written so clearly that any one with an ordinary grammar school education can understand it.

Reclamation Notes

CALIFORNIA.

The Cucamonga Land and Irrigation Company is taking bids for the construction of the second section of concrete pipe line to be laid in their development of acreage near Cucamonga. Plans are being prepared for a system 5,700 feet long. About 1,200 acres will be subdivided and placed on the market in ten-acre tracts.

E. P. Burnham of Hemet has been awarded the contract for the construction of a cement pipe line two miles long on the ranch of Patton Bros. at Winchester.

The Co-operative Land and Trust Company of San Francisco and Los Angeles is installing an irrigation system in the Fairmead colonies, which is creating a great deal of interest in Madera county. The system is being installed in units of 160 acres. Each unit is equipped with a central pumping plant capable of irrigating a quarter section of alfalfa. The plant pumps into a reservoir from which canals radiate to each ten and twenty acre tracts. The entire system—pump, well, reservoir and ditches—goes with the land and is the property of the land owners in the unit. Each acre carries with it one share of stock in the irrigation company which entitles the owner of that acre to sufficient water to irrigate his land. None but the owners of land in a unit have any interest in the irrigation plant, and they control it absolutely.

The Mathieson ranch in the Conejo, near Oxnard, also known as the Potrero ranch, is to be improved, and an irrigation system installed. Two pumping plants are being installed to help carry the water through a pipe line to the ranch.

The Sacramento Valley Irrigation Company and Los Angeles capitalists have purchased large tracts of land between Maxwell and Sites and will construct a reservoir to irrigate the Houx ranch near Sites and other tracts which have been purchased. It is stated that work will commence immediately and that it will take two years' time to complete the reservoir.

Eleven thousand acres of lake land near Portersville is now being drained and will be planted to Egyptian corn, wheat and other cereals. In the shallow portion of Tulare lake four dredges have been installed and these machines have thrown up levees around 3,600 acres of the land and the water is now being pumped out of this section. A huge water wheel propelled by a gas engine, empties the lake, now covering 3,600 acres, into Tulare lake proper. A large pump is pumping water from the same lagoon, this stream being used to irrigate the land already drained and planted to wheat. It is estimated that the cost of reclaiming this land will be \$5 per acre, or a total of \$56,000. The valuation of the property when the improvements are complete will be approximately \$1,000,000.

Irrigation by sprinkling is being tried in California and is meeting with favor, the only drawback being the cost of installation. It is said that by turning on the spray during a cold night the air can be kept above the freezing point.

It is reported that work on the Oakdale irrigation project will be completed and water turned into the canals by October of this year. Over 65,000 acres of land are included in the Oakdale district, and the completion of the work will make a total of about 400,000 acres under irrigation in Stanislaus county.

COLORADO.

The Northern Colorado Irrigation district has filed a contract with the North Poudre and Weld County reservoir company of Denver for construction of an irrigation

system to provide for 50,000 acres of land in northern Weld county. Bonds for \$2,400,000 have been voted to pay for the construction of the project. The district boundaries extend to Carr on the north, Nunn on the south and Dover in its center. Flood water with some district water rights will furnish the supply. The reservoirs will be built from the beds of streams. It is said that the water supply has been investigated and found adequate.

Civil engineers have begun work on the survey to be made for the Dolores river reservoir system. Prominent men, including Senator West, Senator Gove and President Ripley of the Santa Fe Railroad, are interested in this project. The company proposes to bring 200,000 acres of land lying northwest of Cortez, partly in Utah and partly in Colorado, under cultivation. Conservation of the overflow waters of the Dolores river is to be accomplished by reservoirs which will impound 234,000 acre feet at a cost of \$4,000,000.

Construction of three reservoirs to irrigate 20,000 acres of land lying immediately west of Fort Morgan is to be started immediately. A bond issue of \$750,000 has been placed. The company, of which Peter Morris, is president, have paid the state land board \$19,520 for a deed to the state land which lies in the proposed sites for two of the reservoirs. The reservoirs are to have a capacity of 27,000 acre feet. One will be located 20 miles south of Willings, the second seven miles southwest, and the third one and one-half miles south. The bond issue was taken by Dougherty & Co. of Denver. The project is to be known as the Niles Irrigation district.

William R. Kelly of Greeley has been appointed referee in water district No. 1 to succeed the late Judge C. A. Bennett. The adjudication of rights involves over 100,000,000,000 feet of water in this district, which is valued at several millions.

The case of Bert Clark, a Chicago promoter, vs. The Fort Morgan National Bank was dismissed in open court by motion of both parties to the suit. Clark brought suit on the grounds that the Morgan National bank had sold him, under alleged misrepresentation, bonds of the Badger Irrigation & Reservoir company, of the face value of \$240,000. The court awarded judgment to the plaintiff.

President Taft has authorized Secretary of the Interior Fisher to proceed with construction of the Grand Valley Irrigation project in Colorado without awaiting adjudication of the water rights.

An engineering company of Denver has made a report to the farmers of the Oklahoma district in regard to the Nunn Creek reservoir site, located about 60 miles in the mountains west of Loveland. The watershed is sufficient for the irrigation of more than 25,000 acres of land. At the side of the reservoir a dam will be built and water will be sent through a tunnel into the Poudre valley, where it can be turned into the north side ditch and onto the land. About 15,000 acres of land are embraced in the project, which lies five miles northeast of Loveland. S. Q. Jackson of Loveland is president of the promoting company.

The dam of the Roam Creek Irrigation Company project, twenty miles north of De Beque, went out on May 28th, releasing the waters of the basin and washing out bridges and crops the entire length of the valley. Conservative estimates place the loss at more than \$30,000 to the water system and crops. Another dam will be built immediately to store water from the flow from the snow which is not yet melted. It is hoped that enough can be secured for this season's irrigation.

IDAHO.

The power plant at the Boise dam, about 12 miles from Boise, has been thoroughly tried out, and the engineers in charge have submitted a very favorable report to the Reclamation office at Washington, D. C. About 2,000 horse-power will be developed at this plant and transmitted electrically to the Arrowrock damsite, a distance of

about 20 miles, where it will be used for construction purposes.

The Secretary of the Interior has authorized the Reclamation Service to proceed with the construction of the pumping plant, distribution system, and transmission line for the West extension of the Minidoka irrigation project. The extension will cover an area of 2,200 acres of high land lying about six miles northwest of Burley. Water for irrigation will be pumped by power generated at Minidoka dam and transmitted electrically down the valley. The estimated cost of the work is \$72,500.

It is reported that the Portneuf-Marsh Valley Irrigation Company of Downey will undertake the placing of 30,000 acres of bench lands under irrigation. It is said that by raising the water in the present storage dam ten feet higher practically all of the dry farm lands lying on the benches surrounding Marsh Valley can be irrigated. No definite statements have yet been made by the company as to this undertaking.

OREGON.

C. W. Allen of Salem has made application to the state engineer for the appropriation of the waters of Metolius river for the irrigation of 50,000 acres of land lying west of the Deschutes river south of Warm Springs. The plans submitted in the application call for the appropriation of 400 second feet, the construction of a canal seven miles in length and a tunnel through the divide $2\frac{1}{2}$ miles long. Metolius river rises at the foot of Black Butte, a dead volcano standing 300 feet high.

Development of 2,596 acres of fertile land lying in the eastern part of the state is assured as a result of the award of contract for construction of a new pumping plant across the Snake river, three miles south of Weiser, Idaho, on Dead Ox flat. Pipe lines aggregating 15,200 feet in length will be installed and electric motors of 450 horse-power will be used.

Contracts have been let by the Deschutes Irrigation and Power Company for the construction of a dam and canal on its property in Crook county, to cost \$116,000. H. D. Turney, of Columbus, Ohio, who is one of the directors of the company, states that the contract calls for the completion of the work in 120 days. The dam will be 300 feet long and 33 feet high, and the canal will be $1\frac{1}{2}$ miles long. The contract for this work was awarded to L. Gerdetz, of Portland, Oregon.

The Goose Lake Irrigation Company of southern Oregon has executed a mortgage to Thorpe Bros., Minneapolis, Minn., to protect a \$2,000,000 bond issue for improvement work. The company's holdings embrace 70,000 acres of land. Expense of the work completed and under way will be about \$1,000,000 and prospective improvements will consume the other half of the bond issue.

UTAH.

The White Ditch Irrigation Company of Wilford has filed articles of incorporation. The capital stock of the company is \$19,600, in \$100 shares. Edward White, Sr., is president; Theo. Tobiasson, vice-president, and M. W. White, secretary and treasurer.

The Spring Creek Irrigation Company of Holliday will make extensive improvements during the present summer. It is estimated that these improvements will cost approximately \$18,000.

Although prominent Ogden men, interested in the Utah Conservation Company, declare that sufficient progress has not been made to warrant the making public of plans at this time, it is rumored that active construction work will be begun on its southern project in the very near future. Their plans involve the construction of a large reservoir in Weber canyon and the reclamation of about 30,000 acres of land in Weber and Davis counties. Water will be taken from the Weber and Provo rivers for irrigation purposes. It is estimated that the cost of

the Weber canyon dam and reservoir will approximate \$500,000.

The Parish Creek Irrigation Company of Centerville has filed articles of incorporation, with a capital stock of \$2,030, divided into \$10 shares. S. J. Parish is president of the company, W. E. Cheney, vice-president, and W. E. Duncan, secretary and treasurer.

The largest irrigation pump ever made has been purchased by the Associated Canal companies for their plant at the head of Jordan river and will be used to pump water out of Utah lake into Jordan river to supply the canals that irrigate the farms of Salt Lake county. The pump weighs 27 tons. Its capacity will be over 250 cubic feet of water per second, which means an ample supply to irrigate over 2,500 acres of land. Reduced to gallons, this means over 100,000 gallons per minute.

The Land Development Company of Salt Lake City has filed articles of incorporation with the secretary of state; paid up capital stock, \$100,000. The company has purchased 15,400 acres of valuable land in Lander county, Nevada, near Battle Mountain. The land lies in the Artesian belt and within its boundaries are at least six flowing wells.

The Secretary of the Interior has accepted a bid of the Midwest Engineering Company of Omaha, Nebraska, in the sum of \$16,380.30 for the construction of drop, chute and bridge abutments on the Indian creek and Trail Hollow diversion canals of the Strawberry Valley irrigation project.

MISCELLANEOUS.

Contracts entailing an expenditure of \$1,000,000 for the completion of its mammoth irrigation system, near Laramie, Wyoming, upon which \$1,250,000 has already been spent, have been let by the Laramie Water Company, whose main offices are located in Denver. Colorado and eastern capitalists are behind the project which, when completed, will irrigate 150,000 acres of land on all sides of Laramie, Wyoming. Water for irrigation purposes will be taken from the Big and Little Laramie rivers.

The Secretary of the Interior has awarded a contract to Bartlett & Kling of Cedar Rapids, Iowa, whose bid of \$361,378 was the lowest received, for the construction of an earth dam and auxiliary works on the North Platte irrigation project in Nebraska. The work involves the handling of 840,000 cubic yards of material and the placing of 250,000 pounds of reinforcing steel. The contract calls for completion of the work within two years after signing.

The contract for a reservoir dam 96 feet high and 663 feet long across the Tallulah river, near Mathis, Georgia, has been let to the Ambrusen Hydraulic Construction Company of Boston, Mass. The spillway is 288 feet long and will be controlled by automatic flashboards. This dam creates a storage primarily for the benefit of the main development at Tallulah Falls, but it also contains a small power house for utilizing the discharge at peak load periods.

The Tieton unit of the Yakima irrigation district, in Washington, was opened for entry on May 25. Forty-one farms of 21 to 80 acres each are to be had, the consideration being \$93 per acre plus the filing fee. The federal government has already spent \$6,000,000 on this project and expects to spend \$3,000,000 more.

The San Benito Irrigation Company has incorporated to construct canals for the irrigation of 21,685 acres of land, which will be sold in 40-acre tracts. The capital stock of the company is \$100,000; principal office is located at San Benito, Texas.

The Georgia Overhead Irrigation Company, whose principal office is at Rome, Georgia, has filed articles of incorporation. The purpose of the company is to con-

struct overhead irrigation systems. The company is incorporated for \$300,000.

The Secretary of the Interior has awarded contracts for furnishing electrical apparatus for the Truckee-Carson Irrigation project in Nevada, to the Pittsburgh Transformer Company of Pittsburgh, Pa., six transformers the contract price of which is \$2,799, and to the Westinghouse Electric and Manufacturing Company of Los Angeles, California, switchboards apparatus and the electrolytic lightning arresters, the contract price amounting to \$1,739.

Work on the diversion canal of the Pinal Mutual Irrigation Company will be commenced in the near future. This project embraces over 20,000 acres of land lying near the town of Florence, Arizona.

The Indiana-Arizona Irrigated Land Company of Indianapolis, Indiana, has filed articles of incorporation and will place 30,000 acres of fertile land lying north of the city of Prescott, Arizona. The principal offices of the company are located at Indianapolis; capital stock, \$3,000,000.

PRODUCE NEARLY ALL OUR OWN SALT.

Michigan is the second salt-producing state in importance in the Union, being surpassed only by New York. The output of salt in the state in 1910, according to the United States Geological Survey, was 9,452,022 barrels, or 1,323,283 tons, valued at \$2,231,262. Our total salt production in 1910 was 30,305,656 barrels, against only 979,306 barrels imported, valued at \$370,922. At the same time we exported salt to the value of \$320,926.

The indications are that the salt production for 1911 will show an increase over the figures for the preceding year.

CONSERVATION OF WATER IN ROW IRRIGATION.

The difficulty that every farmer experiences in ordinary row irrigation is to so control his supply that the water flows down each row at the same rate and with sufficient velocity so that when the water reaches the lower end of the row the upper end has had time to be sufficiently moistened for the water to reach the roots of the plants. In order to accomplish this, every field should have a ditch running along its highest part, properly laid out. This will be best accomplished by making openings through the side of this ditch through which the water runs into the rows, level; that is to say, fixing them so that when a dam is put in, which brings the water over the bank and forces it through the openings, the water will run through each opening with the same velocity and therefore have the same head. It will, therefore, be a paying proposition to make these openings permanent.

A box made of lumber or concrete with openings in the side, each section set level, with a drop at the end of each section so that by placing the dam at the end of the section, the same quantity of water is discharged through each opening and finds its way to each row and is sent down each with the same velocity and the same quantity of water is supplied to each row. This quantity can be regulated by increasing or decreasing the head on each opening, and with this arrangement it will be found that labor, time and water will be saved.

Another thing, after an irrigation by means of the row method, many farmers have found it advisable and profitable to harrow across the rows. This fills the ditches and the ground that is saturated with loose earth which forms a "dust mulch" and thereby prevents excessive evaporation from the rows, while if this is not done the bottom and sides of the ditches take on a crust, the particles become packed together and excessive evaporation takes place. For the next irrigation it will be necessary to again run the cultivator through the rows in order to form the ditches for another application of water, and by the time this second irrigation occurs the plants will be so far advanced that it will be impossible to harrow a second time, but the first harrowing can be done with very little damage to the crop, in fact it is a benefit to the crop even though some of the plants are destroyed.

E. B. House.

Colorado Experiment Station, Fort Collins, Colo.

Supreme Court Decisions

Irrigation Cases

DRAINAGE ASSESSMENT.

In levying an assessment by a drainage district, that portion of land taken for the right of way of the ditch should not be assessed to the landowner from whose premises it is taken. *Nemaha Valley Drainage Dist. No. 2 v. Stocker*. Supreme Court of Nebraska. 134 Northwestern 183.

POWERS OF IRRIGATION DISTRICT.

Under the provisions of section 2386 of the Revised Codes, an irrigation district has the power and authority to issue bonds for the purpose of collecting drainage, waste, and seepage water, and storing the same for the irrigation of land within such district. *Carlson v. Crescent Woodenware & Box Mfg. Co.* Supreme Court of Idaho. 120 Pacific 460.

APPROPRIATION AS WAIVER OF RIPARIAN RIGHTS.

A settler upon public lands which border upon a non-navigable stream may claim the use of water either as a riparian owner or as an appropriator, but he cannot claim in both rights, since the exercise of one right is in substance the waiver of the other; the tenancy and characteristics of the two rights being essentially different. *Caviness v. La Grande Irr. Co.* Supreme Court of Oregon. 119 Pacific 731.

APPROPRIATION OF WATER RIGHTS.

The quantity of water decreed to an appropriator, in an action wherein the priority of appropriation is the issue, should be upon the basis of cubic feet per second of time of the water actually applied to a beneficial use, and should be definite and certain as to the quantity appropriated and necessarily used by the appropriator. *Lee v. Hanford*. Supreme Court of Idaho. 121 Pacific 558.

"CONSTANT FLOW."

A right to use water for irrigation being limited in time and volume to the extent of the needs of the person in whose favor the right is established for the purpose named, a decree, allowing a "constant flow" of one inch per acre only entitled the owner to a constant flow of that amount when required to irrigate the land to which it was to be applied. *Wolff v. Pomponia. Kershaw Ditch Co. v. Morgan*. Supreme Court of Colorado. 120 Pacific 142.

IRRIGATION ASSESSMENTS.

The owner of land within an irrigation district created under Laws 1909, c. 74, as amended by Laws 1911, c. 53, may seek redress in the courts resulting from any unjust assessment, and raise issues whether his land is being justly assessed or burdened to maintain an irrigation system through which his land cannot be irrigated nor benefited. *Lundberg v. Green River Irrigation Dist.* Supreme Court of Utah. 119 Pacific 1039.

PRESCRIPTIVE RIGHT.

Where a landowner consented to the construction of a flume over his land, and the right given was merely permissive and revocable at any time, the continued maintenance of the flume would not ripen into a prescriptive right; but, if parol consent was given to use the land as though legally conveyed, the continuance of the use for a statutory period would ripen into a prescriptive right. *Gustin v. Harting*. Supreme Court of Wyoming. 121 Pacific 522.

BASIS OF APPROPRIATION.

A settler of 160 acres of government land, who constructs a ditch or buys a water right with a view to apply water to his land, may use such an amount of water as is sufficient to irrigate all his land when needed, provided the water is beneficially used with reasonable diligence in the improvement of the land; and the highest aggregate number of acres irrigated by him in any year is not the basis of a first appropriation of water for irrigation. *Weldon Valley Ditch Co. v. Farmers' Pawnee Canal Co.* Supreme Court of Colorado. 119 Pacific 1056.

WELL CONTRACT.

A contract for the digging of a well stipulated that the well should furnish 1,000 gallons of water per minute. The well dug did not furnish that amount, and the owner agreed to pay a specified sum for a flow of 800 gallons per minute, but the well when tested did not produce more than 650 gallons. *Held*, that the conditional agreement did not prevent the owner from insisting on full performance of the contract.

Simons v. Paine. Court of Civil Appeals of Texas. 140 Southwestern 854.

SALE OF STOCK AND WATER RIGHTS.

An owner of stock in an irrigation company and of water rights thereunder sold the stock and water rights and agreed to take care of the water for the purchaser until such time as he demanded it, and the owner subsequently actually used the water without claiming any title to the stock of water rights. *Held*, that the owner could not plead laches or non-user of the water to defeat the rights of the purchaser. *Wanamaker v. Pendleton*. Court of Appeals of Colorado. 121 Pacific 108.

RIGHTS OF APPROPRIATORS.

Plaintiffs having acquired the right to use of the water of the R. stream by appropriation prior to that of defendant, and having use for it, may not be compelled to forego use thereof, because defendant has use for it, though plaintiffs might use the waters of the D. stream, where, if they were required to resort exclusively to, they would be compelled to either enlarge its use, and thus perhaps infringe on the rights of junior appropriators from it, or restrict their use of water to avoid such infringement. *Boyd v. Huffine*. Supreme Court of Montana. 120 Pacific 228.

RIGHTS OF LOWER PROPRIETOR.

Where a lower riparian proprietor had no knowledge that a dam and a canal constructed by an upper proprietor would increase the diversion of the water of the stream, and the lower proprietor was assured by the president of the upper proprietor, a corporation, that no increased diversion of water was contemplated, the lower proprietor was not barred by laches, resulting from delay until after the completion of the works of the upper proprietor, from suing to enjoin an increased diversion of the waters of the stream caused by such works. *Stevenson v. San Joaquin & K. R. Canal & Irrigation Co.* Supreme Court of California. 121 Pacific 398.

RIPARIAN RIGHTS.

The judgment which declared that defendant might take all the water which he required for indicated purposes, and that, so long as he took a portion of it from a branch, he might take the remainder from the main stream, did not compel defendant to continue to take water from the branch, but gave him the first right to all the water which he might require for the indicated purposes; and, while the rights of a riparian owner are not limited by the quantum of water he may happen to use, the judgment was not erroneous as against defendant. *Filippini v. Hewlett*. Supreme Court of California. 121 Pacific 376.

MAINTENANCE FEE.

A purchaser of land from one who holds a water right contract thereon with an irrigation company, and who takes title thereto by a deed containing the ordinary covenants of warranty with no reference to the question of water rights, and who refuses to accept water from the company, is not personally liable for the maintenance fee mentioned in the water right contract between his grantor and the irrigation company; and an action cannot be maintained against him to recover a personal judgment therefor. *Farmers' & Merchants' Irr. Co. v. Hill*. Supreme Court of Nebraska. 134 Northwestern 929.

TAKING OF CANAL BY CITY.

A city instituted a proceeding under Comp. Laws 1907, § 1288x22, to obtain a right to enlarge an irrigating canal owned by an irrigation company for the purpose of conveying water from a river for the use of its inhabitants. The city already had a canal of its own from the river in question, but, by reason of the canal of the irrigation company being on a higher elevation, it would be more advantageous to the city to convey its water through such canal. *Held*, that the use which the city sought to make of the canal when enlarged was a public use. *Salt Lake City v. East Jordan Irr. Co.* Supreme Court of Utah. 121 Pacific 592.

SUIT AGAINST RECLAMATION OFFICER.

Reclamation Act June 17, 1902, c. 1093, 32 Stat. 388 (U. S. Comp. St. Supp. 1909, p. 596), providing for the construction of irrigation works on the public land by the United States, the cost to be repaid to it by purchasers of the lands irrigated, is not a "revenue law of the United States" within the meaning of Rev. St. § 643 (U. S. Comp. St. 1901, p. 521), authorizing the removal of any suit brought in a state court against any officer appointed under or acting by authority of any revenue law of the United States, and such section does not apply to a suit against the officer in charge of a reclamation

project because of acts done under color of his office. *City of Stanfield v. Umatilla River Water Users' Ass'n.* U. S. Circuit Court, District of Oregon. 192 Federal 596.

DAMAGES FOR FAILURE TO FURNISH WATER.

An irrigation corporation contracted to furnish water from its ditch through laterals or measuring boxes for the irrigation of land so situated as to require the construction of ditches across private property of third persons, and across a state road and a railroad right of way. The right to construct such a ditch was not shown. *Held*, that the owner of the land, not required to construct a ditch, or to obtain a right to do so after the refusal of the corporation to furnish water, could only recover legal interest on his investment, and damages, based on the value of crops which he might have produced with water, if furnished by the corporation, were too remote; the land not having been planted. *Ulrich v. Pateros Water Ditch Co.* Supreme Court of Washington. 121 Pacific 818.

DITCH LICENSE.

A permission, given without consideration by an owner for the use by a township of his land for the discharge across his land of the surplus water of an artesian well sunk by the township on its land for irrigation purposes for the inhabitants of the township, and not given in the form of a grant or conveyance in writing, is a mere license, subject to revocation by the owner or his grantee; a "license," in real estate, being an authority to do a particular act on the land of another without possessing any estate therein, and being founded in personal confidence, revocable at will; and an "easement" being a privilege in land, without profit, existing distinct from the ownership of the land, founded on a grant in writing, within the statute of frauds (Civ. Code, § 1238). *Butz v. Richland Tp.* Supreme Court of South Dakota. 134 Northwestern 895.

IRRIGATION DITCHES.

An owner of land constructed an irrigation ditch and thereby appropriated water from a stream. The notice of appropriation specified the quantity of water. Subsequently he conveyed the lower 80 acres of his tract together with an undivided half of the ditch property and the right of way over the land with appurtenances. The ditch of the owner, as actually constructed, did not carry the quantity of water specified in the notice when the conveyance was made. *Held*, that, though the conveyance created a tenancy in common between the parties as to the ditch with a right to the grantee to extend it, the deed only gave the grantee as a subsequent appropriator a right to the excess of the water not used on the owner's land. *Hufford v. Dye*. Supreme Court of California. 121 Pacific 400.

WYOMING LIEN LAW UNCONSTITUTIONAL.

Sess. Laws 1909, c. 78 (Comp. St. 1910, §§ 3823-3825), providing by section 1 that, whenever any ditch or canal company or other owner shall contract for the construction of its ditch, canal, or reservoir, such company or owner shall take from the contractor a bond conditioned for the payment of persons who supply such contractor with labor, farm products, or goods of any kind, or all just debts incurred in carrying on such work, and, on failure to take such bond, such company or owner shall be liable to the full extent of all such debts of the contractor or subcontractor, in so far as it imposes liabilities beyond the extent to which the property is benefited, violates Const. art. 1, § 6, providing that no person shall be deprived of property without due process of law. *George Bolln Co. v. North Platte Valley Irr. Co.* Supreme Court of Wyoming. 121 Pacific 22.

DAMAGES FOR ENLARGEMENT OF CANAL.

In a proceeding to obtain permission to enlarge the irrigation canals of another under Comp. Laws 1907, § 1288x22, defendants claimed damages for deprivation of the right to enlarge their canals and appropriate additional water and supply others with such water for profit. The decree provided that in enlarging the canals the plaintiff should maintain the existing irregularity of the banks. *Held*, that defendants were not entitled to any such damages, since they had no better right than plaintiff to appropriate any unappropriated water, and, if they could appropriate any more water, there was nothing to prevent them from enlarging their canal; the provision respecting the maintenance of the irregularities of the banks reserving to defendants the benefit of the wider portions of the banks in case they desired to increase their capacity. *Tanner v. Provo Bench Canal & Irrigation Co.* Supreme Court of Utah. 121 Pacific 584.

IRRIGATION DISTRICTS.

Sess. Laws 1909, c. 146, authorizing a majority in number of holders to title to lands susceptible of irrigation from the same general source, and representing a majority in acreage, may petition for the establishment of an irrigation district, and declaring that the provisions of the act shall be liberally construed, etc., does not disqualify one from signing a petition by reason of any special interest; and stockholders of a corporation, interested in effecting a sale of the property of the corporation to the district sought to be organized, are not disqualified from signing the petition and taking part in the organization of the district, or in any of the proceedings thereafter looking to a completion of the sale. *O'Neill v. Yellowstone Irr. Dist.* Supreme Court of Montana. 121 Pacific 283.

IRRIGATION COMPANY.

A contract having been entered into between the Land & Water Company and the Canal Company, whereby the Land & Water Company transferred its entire interests in and to the dams, ditches, water rights, etc., to the Canal Company, and also thereafter transferred to said Canal Company 42,174.51 shares of unsold water rights and authorized the latter corporation to sell said shares or water rights under the provisions of the original contract with the state, and said Canal Company upon proper application made by one who had purchased lands of the state embraced within said project, refused to sell the purchaser a water right for the irrigation of the lands so purchased, *held*, under said contract and the law, that the Canal Company should be compelled by mandate to issue to such purchaser the water rights prayed for. *State v. Twin Falls Canal Co.* Supreme Court of Idaho. 121 Pacific 1039.

SUIT AGAINST RECLAMATION OFFICER.

Reclamation Act June 17, 1902, c. 1093, 32 Stat. 388 (U. S. Comp. St. Supp. 1909, p. 596), by which the government advances the cost of reclamation works, and collects from purchasers of the lands benefited only sufficient to reimburse it for the expenditure, is not a "revenue law" within the meaning of Rev. St. § 643 (U. S. Comp. St. 1901, p. 521), which provides for the removal of suits brought in state courts "against any officer appointed under or acting by authority of any revenue law of the United States" on account of any act done under color of his office, and a suit against the officer in charge of reclamation work to determine water rights in a stream is not removable by him thereunder. Nor is there any reason of public policy why such suit should be transferred to the federal courts, as by the terms of the act the rights of the government as an appropriator of water are governed by the laws of the state and are no greater than those of any other user. *Twin Falls Canal Co., Limited, v. Foote.* U. S. Circuit Court, District of Idaho. 192 Federal 582.

VALUATION OF IRRIGATION PLANT.

Under the Constitution and laws of California which declare the use of the waters of the state appropriated for sale, rental, or distribution to be a public use, and the right to collect compensation therefor a franchise subject to regulation by law, an irrigation company diverting water from a stream for distribution through its canals is merely an intermediate agency between the public, which is the owner of the water, and the owners of the land to which it is applied, who are the real appropriators and owners of the water right, which runs with the land, and is based upon and measured and limited by the beneficial use made of the water. The company has no property in the water or the water right, aside from its franchise, to distribute and collect compensation therefor which a county board is required to consider in estimating the value of its property as a basis for fixing rates to be charged consumers, under Act. Cal. March 12, 1885 (St. 1885, p. 95), but is entitled to have its franchise valued. *San Joaquin & Kings River C. & I. Co., Inc., v. Stanislaus County.* U. S. Circuit Court, Northern District of California. 191 Federal 875.

TITLE TO DITCH RIGHTS.

Where, in an action to quiet title to ditch rights, it was an issue whether plaintiff and his predecessors had acquired a ditch right by prescription, the deed to plaintiff from his grantor conveying the land with appurtenances, but not specifically mentioning the ditch, was admissible in evidence, since, if plaintiff's grantor had at the time acquired the ditch right by prescription, it passed to plaintiff as an appurtenance. *McDonnell v. Huffine.* Supreme Court of Montana. 120 Pacific 792.

CONSENT OF RIPARIAN OWNER.

Where the pleadings showed that the plaintiff and one of the defendants in an action to establish water rights to enjoin diversion by upper riparian users were riparian owners claiming as appropriators, and that the other defendants owned no lands, either riparian or away from the river, but merely conveyed water to such lands, the parties were before the court in the character of appropriators and not as riparian owners. *Caviness v. La Grande Irrigation Company.* Supreme Court of Oregon. 119 Pacific 731.

ADVERSE USE.

Where defendant never did any act which notified plaintiffs or their grantees that he intended to claim a right to constantly divert the waters of the stream or deny their right to use the same share that they had previously employed while defendant's grantor occupied the land, limitations would not attach in favor of defendant's claim to the use of all the water from the fact that at times defendant used all the water, such being his privilege, unless plaintiff's grantors were in need of an amount equal to their diversions. *McCoy v. Huntley.* Supreme Court of Oregon. 119 Pacific 481.

DAMAGES FOR REMOVAL OF FLUME.

Where an owner of land removed a flume therefrom, for the construction of which he had granted a license, and the removal rendered a considerable portion of a ditch of which the flume was a part valueless, the value of the portion of the flume destroyed, or the cost of replacing it, would not be the proper measure of damages, as plaintiff could not go upon defendant's premises to reconstruct it, and he was not required to institute legal proceedings to prevent interference with the flume, so that an instruction that the rule of damages was such immediate and direct damage sustained "both to the flume and to the ditch itself, or to any part or portion of the ditch," was correct. *Jones v. Bondurant.* Court of Appeals of Colorado. 130 Pacific 1047.

WATER RIGHTS.

A petition which alleges that plaintiffs were the owners and in possession of land described, in the semiarid region of the state, that the lands had been supplied with water for irrigation from a ditch under an ancient grant, that defendant operated another ancient ditch under an ancient grant for the irrigation of other lands described, that the two ditches had been continuously used by the owners of the lands, who had shared in the use of the water proportionately, that defendant unjustly began to use practically all of the waters, and during a season unreasonably consumed practically all of the available water, and thereby deprived plaintiffs of their just proportion, causing damages alleged in detail, and which prays for an injunction, states a cause of action for the determination of the water rights of the parties. *San Juan Ditch Company v. Cassin.* Court of Civil Appeals of Texas. 141 Southwestern 815.

DAMAGES FOR FAILURE TO REPAIR PUMPING PLANT.

A lease of rice land bound the lessor to repair an irrigating plant on the land, and he did in fact make most of the repairs, especially those specifically named in the lease, within a reasonable time, but was unable to put a suction pipe in place so that it might be used in pumping water. The pipe was not specifically mentioned in the lease. *Held*, that if the tenant could, at small expense, by the exercise of reasonable diligence, have put the suction pipe in place so as to have pumped the water, he could not recover for damage to the crop from failure to have sooner made the pumping plant available because of the absence of the suction pipe, especially as the tenant had been allowed to retain a considerable sum due for rent to apply on the expense of making repairs; the general rule that the tenant may rely upon a landlord's covenant to make repairs and recover for the depreciation in rental value resulting from his failure to do so not applying. *Reinking v. Goodell.* Supreme Court of Iowa. 133 Northwestern 774.

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A GENERAL PURPOSE FARM TRACTOR.**By Raymond Olney.**

By the term "general purpose farm tractor" is meant a traction engine that will replace to a large extent the use of horses on the farm. This modern farm horse made its appearance but a few years ago. Since then it has undergone a marvelous development. The demand for these machines has been so great that traction engine manufacturers have not been able at times to supply them fast enough.

About two years ago the M. Rumely Company, 1751 Main street, LaPorte, Indiana, began building an internal-combustion, kerosene-burning tractor, known as the Oil-Pull. During the first year less than 100 of these engines were manufactured and sold. At the present time, as many as 75 per week are being turned out. In spite of this enormous output, the demand still exceeds the supply.

The Oil-Pull is made in three different sizes. The smallest of these is the type "F," a 15-tractive, 30-brake horsepower tractor. This engine is designed especially for use on the smaller farms. It will do the work of 15 good average horses pulling on the same load continuously day after day.

For fuel the Oil-Pull tractor uses the cheaper grades of kerosene and distillate, and all crude oils that do not have an asphalt base. It is the only oil-burning engine, which burns the heavier fuels economically at all loads, and under all temperature and atmospheric conditions. This has been made possible by the use of the Secor-Higgins system of oil combustion. This system is thoroughly covered by patents, which are owned and controlled exclusively by the M. Rumely Company.

This tractor will not only replace the horse for a greater part of the farm work, but for the heaviest of it as well. It is particularly well adapted to such work as plowing, harrowing, seeding, harvesting, threshing, hauling, road-making, and for all kinds of stationary work.

In plowing, it will haul an engine gang of from 4 to 6 14-inch plows, depending upon the conditions and the load hauled. And here lies an important advantage in this connection. The farmer, during the plowing season, does not have to limit his work day to 8 or 10 hours, as he must necessarily do when using horses. This tractor will work 20 hours per day just as easily and efficiently as it will less. It is tireless and the more it is used, so much more will the farmer realize on his investment.

By doubling the working hours per day, the work can be done just at the right time. The plowing and other spring work can be completed when the best weather and moisture conditions prevail. Grain can be harvested when the crop is in the proper condition. All this results in improving the quality of the work done and increasing crop production.

Having, as it does, a large power capacity, this tractor will haul a number of different implements at one time. The fact that by its use it is possible to combine operations makes it a valuable asset. This advantage is more fully appreciated at certain rush times during the year, such as spring work, summer fallowing, harvesting, etc. It is usually desirable and essential that such work be accomplished with all possible speed. Combining operations brings about a saving in time, labor and much anxiety and worry on the part of the farmer.

In the operation of plowing, discs and smoothing harrows may be hitched behind the plows. In this way the ground is made ready for seeding at one operation. The soil, instead of lying loose in large lumps for the air to penetrate and dry it out, is pulverized and a mulch formed to do away with surface evaporation. If horses were used, the plows, discs, and harrows would have to be hauled separately, thus requiring 3 operations in place of one with the tractor.

The operation of seeding is accomplished with the Oil-Pull by hauling discs, drills, packers and harrows behind it at one time. Once over the field with this outfit and the seeding is completed. In many instances farmers find it convenient to plow and seed at one and the same time. This is an insurance against the rapid evaporation of soil water, which is sure to result, when the work is divided up into several operations with horses.

In summer fallowing, this tractor will haul 30 feet of discs and harrows, and cover from 70 to 80 acres per day. At times where there is danger of excessive evaporation, by working the outfit day and night, almost double this amount of work can be accomplished.

The farm tractor is now conceded to be not only a practical, but an economical proposition as well. The fact that cheap kerosene can be used as fuel greatly decreases the cost of operation. It can now be obtained in car lots at from 5 to 7 cents per gallon. The traction engine has come to stay, not in the sense of completely displacing the horse, but for replacing the horse for the drudgery of farm work.



An Oliver Engine Gang Plow Drawn by a Rumely "Oil Pull" Engine on the Kankakee Marsh near Crumstown, Ind.

IRRIGATION AND DRAINAGE

By Samuel H. Lea, State Engineer of South Dakota.*

Irrigation in the United States is largely confined to the great region situated west of the Missouri River. This area includes the western portions of North and South Dakota, Nebraska, Kansas and Texas, all of Montana, Wyoming, Colorado, New Mexico, Idaho, Arizona, Utah and Nevada, the most of California, and much of the eastern portions of Washington and Oregon, and a small portion of Oklahoma.

The aggregate area embraced in this list is about 1,260,000 square miles, equal in extent to thirty states the size of Ohio, or about two-fifths of the continental United States.

In this immense area there are now in operation, under construction and projected many irrigation projects of various degrees of importance, ranging from the small individual diversion works to the great projects of the United States Reclamation Service. The expenditure of many millions of dollars has resulted in the reclamation of vast areas of arid lands, transforming barren wastes into green fields yielding bountiful harvests.

As a rule the irrigation of land is effected from flowing streams, the water being diverted from the channel and conveyed over the land through ditches, flumes and conduits. In some cases reservoirs are prepared for storing the water when it is not required for immediate use, thus utilizing as nearly as practicable the full flow of the stream. Other systems of irrigation comprise pumping from a stream or lake or from an underground source of supply.

The area of land under irrigation is constantly increasing and in course of time the limit of water supply available for such use will be reached. This is already the case in some sections and the problem confronting the irrigator under such a condition is where to obtain a supply of water for irrigation. In some localities away from flowing streams irrigation is carried on by the use of water obtained during flood periods by storage in small reservoirs. Such reservoirs, while having small individual capacity, will in the aggregate store large volumes of water that would otherwise go to waste in periods of flood or heavy rainfall. In this way some good results are obtained in mitigating the effects of overflow and inundation in the larger streams. Of course, no great quantity of water in any one stream is thus held back, but it is expected that eventually a decided benefit in this respect will be effected when the number of reservoirs for impounding storm water has been increased to the maximum limit.

Development of Irrigation.

According to the last national census, the total acreage under irrigation in the arid and semi-arid states is given as 13,739,499 acres. This is an increase of 82.5 per cent in the last decade, and 278.3 per cent in the last two decades. The total area of irrigable land in the United States included in present projects and yet to be irrigated, comprises 31,112,110 acres. This vast area does not contain the total irrigable land we have; it is probably about half of what will ultimately be irrigated in the arid region. Prof. Fother, an authority on irrigation matters, estimates that the area susceptible of successful irrigation in this country, about 50,000,000 acres of land in the arid region, this area being all that the visible water supply in the territory designated will cover to advantage. When the ultimate development in irrigation in the West is reached, say in about 20 years, the irrigated section will support a population several times greater than at present, and land values will be proportionately higher.

The extension of irrigation will result in a better conservation of our water supply, also in a more economical and effective use of irrigation water than is now practiced. As land values increase, improved methods of irrigation will be adopted and water will be made to perform a much greater duty than at present.

Regulation of Stream Flow.

With the development of irrigation, involving as it does

the conservation of flood waters, we may expect one beneficial result in a greater degree of continuity of flow in our streams. In the navigable rivers a reasonable regulation of flow is a consummation that is accomplished, would mean much to navigation. Nature provides through the snow and rainfall a supply of water to the drainage area of a stream system, that with proper conservation, could be distributed along the main channel throughout the season to great advantage.

In diverting water from a stream channel for irrigation purposes the stream flow is not permanently depleted as would at first appear. While a considerable portion of the water so diverted is consumed by evaporation and by the growth of plants, a large percentage collects on the lower levels of the adjacent land in the form of seepage, and this water eventually finds its way back to the channel.

We are looking forward to the day when our large rivers shall become as easily and effectively managed as the water in the distribution pipes of a large city. This is the highest conception of water conservation, and when it is accomplished, the problems of flood prevention, navigation, irrigation, water power and municipal water supply will be largely solved. In the course of time we may reasonably hope that by the extension of irrigation, the improvement of methods of using irrigation water, and the conservation of flood waters, the great Missouri River may have its flood height reduced and its high water period materially shortened.

Eventually, from the same source, we may expect to see the low water stage improved by the return of seepage water to the river from tributary streams and reservoirs after this water has performed useful work in the way of irrigation. The regulation of stream flow in other than irrigated sections may be effected by other agencies, as will be seen later on.

Reclamation by Drainage.

Vast as is the area that will be ultimately reclaimed by irrigation in the United States, it is not as great as that which requires drainage. While irrigation is considered necessary in only a portion of the area covered by the continental United States, drainage reclamation is required in forty-one states of the Union. From this we can readily see that in the work of reclaiming agricultural lands, and the drainage of swamp and overflowed lands may be considered as being fully as important as irrigation. Both are important factors in the development of our country and both deserve recognition and attention by all who have the welfare of our country at heart. Irrigation is receiving national assistance, and deservedly so; now let us have equal recognition for drainage.

Conditions in South Dakota.

In South Dakota, as in other western states, there are considerable areas of splendid agricultural lands that are either partially or wholly under water and that can be reclaimed only by drainage. The cost of drainage with us is relatively small when compared with the present value of the land. In many instances, however, the cost per acre would be prohibitory were it not the case that the lands have a high intrinsic value. As is generally the case where agricultural lands require drainage, the wet areas comprise some of the best lands we have and we cannot afford to leave them undrained. We now have proposed and under way many important projects for drainage reclamation, and hundreds of miles of ditches will have been constructed when present projects are completed.

The general supervision of both irrigation and drainage work in South Dakota is under the State Engineer's department. While the western half of the state is concerned largely with irrigation, in the eastern half drainage problems require our attention. Under the provisions of the state drainage code, petitions have been filed in the State Engineer's office calling for the establishment of drainage over an area comprising about 330,000 acres of land; and involving the construction of 425 miles of main ditches and about 1,000 miles of laterals; this area is distributed over 27 counties in the state east of the Missouri River.

Some of our drainage problems are complicated and require considerable engineering skill to design and carry out. One project that was completed about two years ago, drains several thousand acres in the Sioux River valley. This project, which was designed in the State Engineer's office, requires a main canal having a capacity of about 2,000 second feet of water. The discharge is through an outlet

*Address delivered at the Second National Drainage Congress, New Orleans, La., April 10-13, 1912.

channel 1,200 feet long with a grade of from 9 to 11 per cent; this outlet is lined with reinforced concrete as a protection against erosion of the banks from the rushing flood of water.

Another project, recently completed, covers 70,000 acres of land in the Vermillion River valley. This required a canal of such dimensions that it is locally known as Little Panama. Still another project along the Vermillion River, now under construction, comprises a canal having a width of 80 feet at the bottom, and with a capacity of 3,000 cubic feet of water per second.

A drainage project in Clark County contemplates the drainage of an old lake bed that has no natural outlet. The area to be drained covers only about 3,000 acres but the land is rich and will be quite valuable after being reclaimed. In order to carry out the project it will be necessary to construct an outlet tunnel through the surrounding range of hills; the work will require an expenditure of about \$100,000, or at the rate of \$36 an acre for the land reclaimed.

Importance of Drainage.

From the foregoing it will be seen that even in states situated in the higher altitudes near the middle of the continent, there are large areas requiring reclamation by drainage. These areas are, however, insignificant in extent as compared with the wet areas of the states along the Gulf and Atlantic Seaboard. A very large proportion of the 70,000,000 acres requiring drainage in this country, is comprised in these states. The question is really one of national importance.

Many of the larger basins to be reclaimed lie in more than one state, and in such cases questions of interstate jurisdiction are involved. It would seem that the treatment of such problems should logically be left to a national commission, acting in harmony with the state authorities.

Prospective Benefits.

Drainage is not entirely a private or individual benefit. For every acre of non-productive wet land that is reclaimed by drainage, a corresponding benefit accrues to the general

public by increase in property values and by addition to the taxable values of the commonwealth. Another valuable public benefit resulting from drainage is the improvement of the public roads.

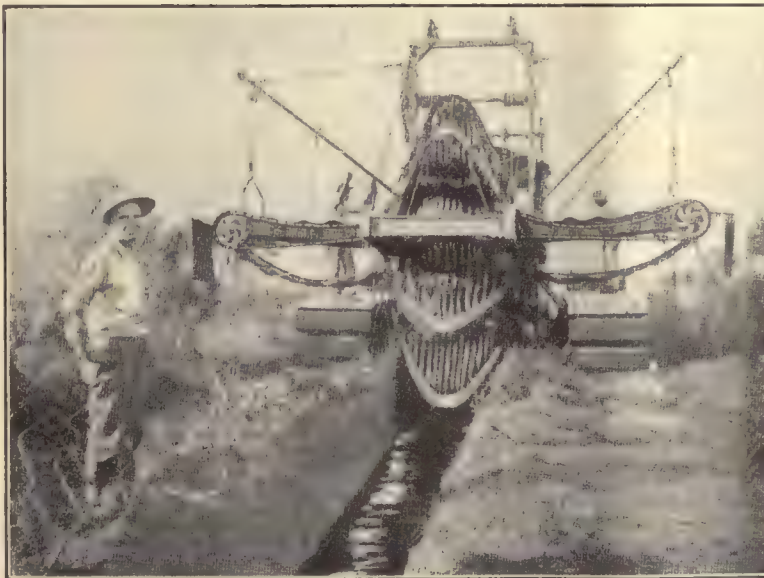
Still another and greater public benefit resulting from drainage is health. In confirmation of this statement I will quote from an address made at the annual meeting of the Iowa State Drainage Association in Fort Dodge in February, 1910, by the president of that association: "In 1870, of every 1,000 deaths in the state, 52 were from malaria; more than five per cent of the mortality at that time was due to the sloughs and ponds and stagnant water—breeding places for mosquitoes, the carriers of infection. Today the word malaria is scarcely found in the vocabulary of the Iowa doctor. Deaths from malaria have reached the cipher point in our state. Drainage result—greater production, more taxable property, better roads and better health." These words from a drainage authority in one of our prosperous and progressive western states carry the weight of actual experience.

The Effect of Drainage on Stream Flow.

The general problem of drainage involves deeper questions than simply removing surplus water from agricultural lands. Where drainage can be handled under central supervision suitable provision will be made for reclaiming entire districts under some comprehensive general plan instead of providing temporary relief for isolated areas. The broad view looking toward the caring for an entire watershed and the needs of all the land affected therein must be taken and not merely the needs of a single swamp or submerged area.

Another factor must be considered in the general problem; this comprises the effect upon a stream or water-course of discharging a large volume of water from drainage ditches into the channel. In many cases it is found advisable to take advantage of natural reservoirs in the forms of lakes or ponds, lying sufficiently low to receive the drainage from adjacent wet areas. Such lakes are thus made to serve as storage reservoirs for conserving

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waters that would otherwise be a source of danger and injury to the general welfare.

Such procedure would also be in line with the general policy of the conservation of our natural resources. Large quantities of water that would otherwise go to waste and that would be actually injurious and cause devastation by flowing down the regular channels in great volumes, could thus be partially held in check by at least holding back the crest of the flood, if sufficient storage capacity could be provided. It is not thought that a great amount of flood discharge could be actually held back by incidental storage in reservoirs such as have been designated, but there would be at least a considerable benefit resulting from such storage.

A comprehensive system of land drainage comprises first of all the formation of sufficient channel capacity for draining a given area so as to take care of the surface water, and also to furnish outlets for farm or local drainage. These channels are usually open ditches; they may if sufficiently deep, act as receiving drains for sub-surface or tile drains. When an area is provided with complete facilities for under-drainage it then becomes in effect a reservoir of more or less extent, with a depth equal to that of the sub-surface channels. In this way a portion of the surplus water goes directly to the stream channel, while part sinks into the porous ground to escape later through the underground channels. A temporary reservoir is thus provided for a considerable portion of the water, and while such a reservoir would not afford facilities for lengthy storage, still the aggregate volume of water that would be held back would in some cases be considerable. It is believed that ultimately, when large areas of lands comprising entire river valleys, shall be provided with tile drains, the problem of flood regulation in such streams will be largely solved.

The extension of agriculture is the basis of future growth and development and the reclamation of agricultural lands by irrigation and drainage should be encouraged by every legitimate means. No less important are the questions of public health and the development of river navigation. These vital questions are largely dependent upon the regulation of our surface water supplies, and such regulation should be effected in a scientific, comprehensive way, preferably under national supervision. We have the practical example of the national Reclamation Service in reclaiming large tracts of air land by establishing great irrigation projects. Let us now encourage the drainage engineers in their great work of converting stagnant ponds and pestilential swamps into productive fields capable of supporting dense populations in comfort and plenty.

Let us press forward in the good work of reclamation, making possible the growth of population and commerce, the continuance of prosperity, the upbuilding of great commercial centers like unto this splendid Crescent City, and the transformation of a vast region into a world factor of the first importance.

BUSINESS OPPORTUNITIES IN THE WEST.

The "back to the land" movement that has drawn so many city people countryward during the last few years has built up many thriving agricultural communities in various parts of the West. On the Government reclamation projects it is estimated that more than 14,000 families have recently taken up their homes. Anticipating the needs of settlers for convenient supply stations and markets the Government engineers in laying out the project set aside tracts at convenient intervals as Government townsites, and auction sales of town lots have been held from time to time as the need arose for business locations and residences. Agricultural activities on the thirty Government projects have reached a point where the prosperity of the settlers is assured and business men are eagerly taking advantage of the opportunities offered at this time to get in on the ground floor in the new towns.

The statistician of the United States Reclamation Service at Washington, D. C., is receiving hundreds of letters from professional and business men and artisans who are anxious to establish themselves in these thriving communities.

On April 4 there will be an auction sale of lots in the town of Powell, which is centrally located in the Shoshone project in northern Wyoming, and on April 18 lots will be sold in three towns on the Huntley's project, Montana,

namely Worden, Ballantine and Pompey's Pillar. In addition several Government towns on other projects have lots now on sale. These include both business and residence locations and the terms are easy.

There is need in several sections for general merchandise, drug, and hardware and implement stores, livery stables, hotels, meat markets, banks. Doctors, dentists, and veterinary surgeons are needed and there are splendid openings for many industries.

On most of the projects there is already enough dairy stock to support a creamery. The townsites are located on railroad lines and potato and truck warehouses would be profitable. Banks which have already been established in several of the towns are in a flourishing condition, and settlers on the newer tracts are reaching the stage where they will become depositors. In some sections the settlers are obliged to go thirty miles for their drug supplies. Alfalfa meal mills, cement block factories, combination millinery and dressmaking, livery stable and veterinary surgeon, harness, implement and hardware stores would be sure to prove profitable.

Many of the residence lots contain from one to five acres where bees, truck farming, poultry raising and dairying on a small scale would be remunerative. On some of the projects there are still small farms adjacent to the townsites which could be operated in connection with a business in town.

There never has been a time when so many opportunities existed under as favorable conditions. Schools and churches have been established and modern conveniences have eliminated most of the hardships of pioneer life.

J. N. Nail and W. F. White, who own a tract of land embracing 700 acres near the town of Fort Worth, in Tarrant county, are installing a pumping plant to irrigate their land. They will use two eight-inch centrifugal pumps operated by 40 h. p. gasoline engines to lift the water to the level of the ditches, which are to have a carrying capacity of 15 cubic feet per second.



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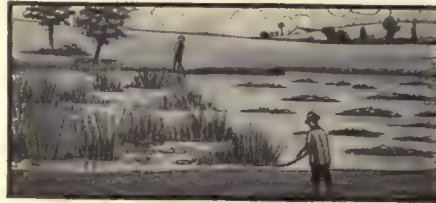


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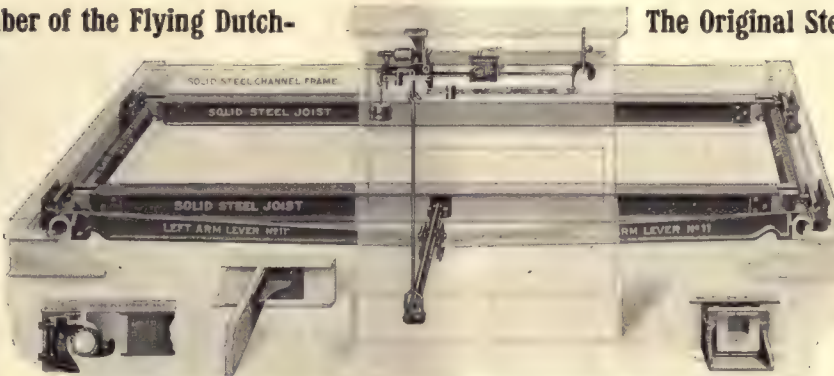
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Absolutely Accurate,
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The McDonald Pitless represents the highest quality of workmanship, material and finish, it is the most substantial in construction and will support the heaviest weights in the most accurate manner. The average shipping weight of the four and five-ton McDonald Pitless with frame 8 by 14 feet is 1,650 pounds; please compare this weight to some other scale that you have in view, you will find that we put from 300 to 500 pounds more material in the construction of the "McDonald Pitless," which insures correct weights under a heavy load; while the lighter constructed scale may weigh a light load accurately you will find in most cases the scales of lighter construction will vary, causing you a loss from which there is no possible recovery.

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Organizations and individuals interested in reclamation are invited to become members. Detailed information concerning initiation fees and dues will be furnished upon application to the secretary. Address

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TITANIUM AND ALLOYS OF STEEL.

Much experimenting with various alloys of steel has been carried on by railroads and rolling-mill operators to produce a rail that will give more satisfactory service than the ordinary rail now in use. One of the principal metals used in these experiments is titanium. More than 250,000 long tons of rails were rolled in 1910 from steel to which ferro-titanium had been added. More than 150,000 tons of steel rails in which nickel or nickel and chromium were used as alloy were also made during 1910, and experiments were made with about 80,000 tons of steel rails in which chromium, manganese, vanadium and other metals were used. Certain steel makers are now advertising titanium steel, claiming that it effects the removal of gases and impurities and thus greatly increases the good quality of the steel.

RAPID DEVELOPMENT IN AGRICULTURE.

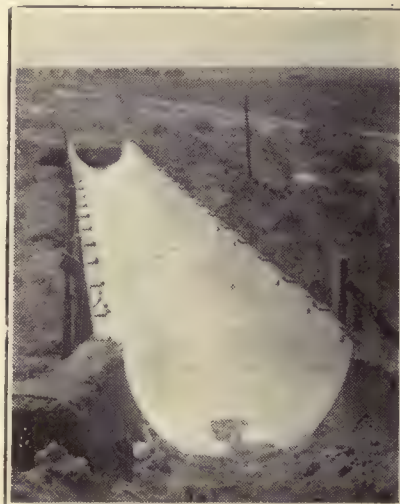
To stimulate a more widespread interest in the study of agriculture throughout the United States, Secretary of Agriculture Wilson has begun a campaign of publicity. Already the department has sent out a great deal of literature bearing on the subject in a general way. Its efforts in the future will be concentrated, so as to actively interest the farmers through a series of practical demonstrations conducted at central stations. Lectures at the various colleges will also be given at certain times in the year, to which all those interested in farming will be invited.

The American system of agricultural education has been highly developed. It includes a number of different classes of institutions which provide all grades of instruction, from graduate courses leading to the doctor's degree to nature study courses in the kindergarten and primary schools. The secondary and elementary instruction is of comparatively recent development, but is becoming an important factor in American education. The graduate and collegiate courses, on the other hand, are well established and take rank with the best agricultural courses in the older universities and colleges in Europe. The institutions for instruction and research in agriculture are brought together to constitute a national system of higher education through the Association

The Leavitt Metal Flume

First cost cheaper than wooden flume—will last three times as long. Open waterway. Nothing to catch trash and weeds.

Requires only a few posts and stringers for support. The Flume itself can be put together with a wrench. Shipped in three foot sections, with complete instructions. No solder or rivets. Joints guaranteed not to leak. Top widths from 12 to 90 inches.



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Our Flume Capacity Table will prove valuable to engineers and waters users. Shows hydraulic radius, velocity and capacity for all sizes and grades.

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of American Agricultural Colleges and Experiment Stations, the office of Experiment Stations of the Department of Agriculture, and the Bureau of Education of the Department of the Interior.

At the head of the system of agricultural education stands the United States Department of Agriculture and the agricultural experiment stations in the different states and territories. Organized primarily with a reference to research, both the department and the stations to a considerable extent directly promote agricultural education, in the technical sense, by giving instruction to students. This is done by opening their laboratories to assistants, who participate in research work while continuing their studies.

The work of the Department of Agriculture along educational lines is rapidly increasing. Not only does it continue to open its laboratories and libraries to officers of the agricultural colleges and experiment stations who come here to carry on special investigations, but its different bureaus, offices and divisions are doing much to encourage all phases of agricultural education throughout the country.

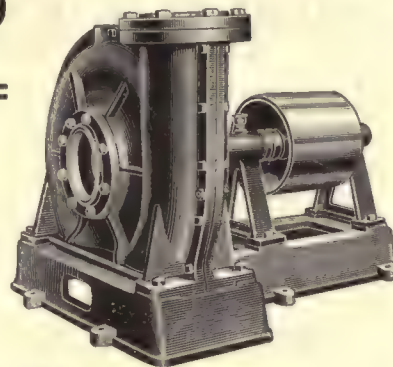
The Weather Bureau is taking active part in public education along meteorological lines. The Bureau of Plant Industry is aiding the movement by distributing to a large number of schools special packages for planting and care of school gardens. The Forest Service is reaching many educators with literature, lantern slides and other illustrative material concerning the conservation of the forest resources of the country, and the Office of Public Roads is training road engineers.

The office of Experiment Station, however, is the general agency of the Department of Agriculture in the promotion of agricultural education. The work is organized into two branches, one dealing with agricultural colleges and schools, and the other with farmers' institutes and other forms of extension work in agriculture. In relation to the work of the farmers' institutes the office collects data respecting conditions and progress of farmers' institutes in the United States and Europe, prepares lecture courses of study for movable schools of agriculture, conducts correspondence with persons interested in agricultural education, visits educational institu-

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The *Irrigation Age* has established a book department for the benefit of its readers. Any of the following named books on Irrigation and Drainage will be forwarded, postpaid, on receipt of price:

Irrigation Institutions, Elwood Mead.....	\$1.25
Irrigation Engineering, Herbert M. Wilson.....	4.00
The Primer of Irrigation, Anderson.....	2.00
Irrigation and Drainage, F. H. King.....	1.50
Irrigation for Farm and Garden, Stewart.....	1.00
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Road Preservation and Dust Prevention, Wm. P.	
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Present price \$42,000.00. One-fourth cash, balance easy terms. Will divide into 120 acres and 200 acre tracts. For the person or persons buying the whole. This tract is improved. Near railroad between Alamosa and Monte Vista. Am selling because I am entering other business. An ideal Western Ranch.

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We are agents for the Chimayo Reservation Navajo Blankets and they come to us direct from the Indian weaver.

The kind that costs you \$50 in Chicago we will sell you for \$10. We have some excellent Navajo Blankets as low as \$6.

We guarantee satisfaction and will ship goods subject to inspection and approval. If not satisfied we will refund any money paid. We refer to The First National Bank of Durango as to our financial responsibility. : : : :

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tions, lectures before representative farmers' assemblies, and acts as a clearing house in securing speakers from the Department of Agriculture and other sources for institute service.

Graduate work in agriculture has been offered by some of the agricultural colleges for many years, but in the last few years, as a result of the rapid development in the science of agriculture, the character of graduate work has improved, and the number of institutions offering graduate courses in agriculture has greatly increased.

STREAMS WHICH FLOW TWO WAYS.

In the northern part of Minnesota there is a great area of land so flat that its waters sometimes flow into Hudson Bay and sometimes into the Gulf of Mexico. This area contains the headwaters of Mississippi river. There are times when certain lakes discharge at both ends, the northern outlet taking the flow through Red river or Rainy river into Lake Winnipeg, and thence into Hudson Bay; while the southern outlet leads to the Mississippi. Therefore the dividing line between the Mississippi drainage basin and that of Hudson Bay is indefinite and in many places can not be determined, and the consideration of these two basins in connection with their water supplies and the uses that can be made thereof must logically be taken up together. The Geological Survey discusses the Hudson Bay and Mississippi river basins in its recent publication, officially known as Water-Supply Paper 285.

NEW TYPE OF OIL.

The oil from the large well recently drilled by the Myles Mineral Co. at Pine Prairie, La., is remarkable, according to an analysis made by the United States Geological Survey, in that it contains no asphalt, gasoline, or paraffin wax. The crude product contains a very large percentage of illuminating oil. In composition the oil stands about halfway between the oil of the gulf field and that of the Caddo field.

One Irrigation a Year

By using the Campbell System of Scientific Farming you can produce a bumper crop on one-half the water ordinarily used. It is done by better tillage and a thorough conservation of the moisture and plant food. Many irrigationists are developing their orchards and maturing their fruit on one irrigation a year by employing the Campbell System—storing the water in the soil. This system prevents leaching, and keeps the soil fertile and sweet at all times. You are not bothered with alkalinity. Your land is never water-logged, thus depriving the plant of the necessary air to insure a quick healthy growth. Plants do not grow while the soil is water soaked.

The Campbell Correspondence School

is the result of thirty years' experiment and demonstration by Prof. Campbell and his associates. This course teaches when to plow, how deep to turn the ground, all about cultivation, and the time WHEN and HOW to do the work.

THE CAMPBELL SYSTEM is used the world over. It is practiced in Spain, Hungary, Italy, India, Australia and North and South America. Wherever intelligently used, by irrigator or dry land farmer, it has doubled the yield.

Send us your name and address on a postal and we will mail you, **FREE**, a copy of the Scientific Farmer and a catalog of the Correspondence School.

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FATTENING HOGS ON ALFALFA IN NEBRASKA.

The Nebraska Experiment Station has just issued Bulletin No. 123 with the above named title.

Part I gives the results of fattening hogs on corn and alfalfa hay. In the experiments reported, the hogs were fed the following rations. The proportions of alfalfa and corn are given by weight.

Corn and alfalfa hay in a rack.

Corn 9 parts, chopped alfalfa 1 part.

Corn 9 parts, alfalfa-meal 1 part.

Corn only.

Corn 3 parts, alfalfa-meal 1 part.

Corn 3 parts, chopped alfalfa 1 part.

Corn 1 part, chopped alfalfa 1 part.

Corn 1 part, alfalfa-meal 1 part.

The hogs were given all the feed they would eat twice daily. Part of the experiment was repeated three times and part of it four times. There were ten spring shoats used in each lot. The feeding period began about November 1, when the shoats weighed 135 pounds each, and continued for three months, at which time the average weight ranged from 190 pounds for those fed one-half alfalfa and one-half corn to 283 for those fed one part alfalfa and nine parts corn.

The prices used in computing the results were the average prices for corn and for hogs at the North Platte Substation during the six years preceding 1911. The price of corn was 47 cts. per bushel. The price of hogs when put into the experiment and when taken out was \$5.90 per 100 lbs. The price of alfalfa hay was \$8.00 per ton, of chopped alfalfa \$10.00 per ton, and of alfalfa-meal \$15.00 per ton. The only item of cost taken into account is the feed. The labor and investment, being about equal for all lots, is not considered.

The corn was ground for all the hogs. The chopped alfalfa and the alfalfa-meal were mixed with the ground corn. All feed was moistened in the trough. The hogs were fed from the first of November until the first of February, or three months.

The rations are arranged above according to the profit on the pigs fattened on each ration. The most profitable

Opportunities Beckon at Del Norte

A welcome awaits you here, Mr. Homeseeker, Farmer, Investor and Land Buyer. The Del Norte section of the famous San Luis Valley, Colorado, offers you opportunities and advantages in the way of new homes, fertile irrigated land, safe investment and bountiful water supply, second to none in the Western States. A delightful climate, churches, schools, pure water, fertile soil and thousands of acres of government homestead and state lands are what we offer. Send for our booklet, "FACTS ABOUT DEL NORTE SECTION." A postal brings it.

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GENERAL PASSENGER AGENT

—Denver, Colo.—



ration, corn with alfalfa hay fed in a rack, is at the top of the list. The first three rations stand closely together. Corn seems to have a stationary place between a ration of 10 parts alfalfa and 90 parts corn and a ration of 25 parts alfalfa and 75 parts corn.

With corn worth 60 cents per bushel a ration of one-fourth alfalfa and three-fourths corn gives nearly the same profit per pig fattened as a ration of corn alone.

Where alfalfa was fed in the rack or where chopped alfalfa or alfalfa-meal were fed in the proportion of one pound of alfalfa to nine pounds of corn, a pound of alfalfa was worth more than a pound of corn.

Part II gives the results of substituting other grains and mill products for a part of the corn in a ration of corn and alfalfa for growing and fattening hogs. The experiments were conducted during the summer and winter. The number of pigs in each lot varied from 10 to 30. The prices used in computing the results are the average prices paid for the various kinds of feeds during the progress of the

experiments. The results of these tests given very briefly are as follows:

Of the many rations tried for fattening hogs, none has been found the equal of corn and a small percentage of alfalfa.

Wheat gives faster gains with less grain per 100 pounds of gain than corn, but the high cost of wheat makes the gains from wheat more expensive than from corn. The profit per pig, if fed one-half wheat and one-half corn while being grown and fattened, is less than if fed corn. This is when both grains are fed with alfalfa.

A ration of barley and corn with alfalfa does not give as fast gain or as much profit per hog during the growing and the fattening periods as a ration of corn and alfalfa.

The substitution of 5 parts tannage, 5 parts bone-meal, or 25 parts shorts, for corn, in a ration containing 90 parts corn and 10 parts chopped alfalfa, increases the cost of gains and decreases the profit per pig during the fattening period.

The substitution of 25 parts emmer, barley, wheat, or milo, for corn, in a ration containing 90 parts corn and 10 parts chopped alfalfa, increases the cost of gains and decreases the profit per hog during the fattening period, excepting emmer, which in this test only increased the profit per hog. The wheat increased the gains but decreased the profit. The emmer also increased the gain. Barley and milo decreased the gain as well as the profit. Milo was worth the same price per bushel as barley in this test.

The results of one test indicated that



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Saves fifty per cent of fuel.

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a bushel of corn was worth as much as a bushel and a half of cane seed when fed with alfalfa for fattening hogs.

Where fall pigs were wintered and turned on alfalfa pasture in the spring, there was more profit per pig from those grown out largely on pasture and then fattened than from those fed out more quickly.

Four seasons' records show that old sows being fattened on corn and alfalfa pasture gained 2 pounds per head daily, ate 355 pounds of corn for 100 pounds of gain, and gave a net profit of over 5 cents daily.

A summary of the results recorded in Bulletin 121 together with data from this Bulletin 123 indicates that the cost of feed to produce a 225-pound market hog was \$3.35 per 100 pounds and that keeping the hog until it weighed 325 pounds increased the cost to \$3.57 per 100 pounds. This includes only the cost of feed and does not include the cost of labor, equipment, unusual risk, or interest on investment.

This bulletin may be had free of cost by residents of Nebraska upon application to the Nebraska Agricultural Experiment Station, Lincoln.

E. A. BURNETT, Director.

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was awarded the Guggenheim Cup for the best display of perfect fruit in competition with the United States at

The National Irrigation Congress in Pueblo, 1911

- ¶ At the National Horticultural Congress in Council Bluffs, Iowa, it received 36 awards of 42 entries.
- ¶ The result of fruit growing in Delta County has been one of continued and uninterrupted success.
- ¶ The intelligent farmer and investor knows that irrigated lands are the best and safest investment in the world. In Delta County he can obtain the best land, the best water rights, in a section in which the towns of Delta, Hotchkiss, Cedaredge, Paonia and Austin are not only home markets but also convenient railroad shipping points. Delta County is not only the banner fruit county of Colorado but yields immense crops of wheat, oats, grain, alfalfa and is an excellent poultry, dairy and live stock section.
- ¶ We can sell you some of the best farming land with perfect water rights at \$150 an acre—Write for further information and illustrated booklet.

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Goodhue Windmills are strong, durable and safe, are self-oiling, close governing and will get the most power out of any wind. Write us today for our catalogue and the details of our really remarkable proposition. Delays are expensive. Do not delay.

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Detroit Irrigation Plants

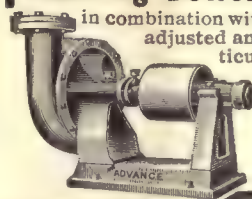
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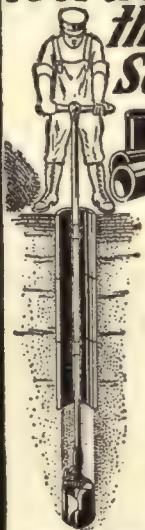
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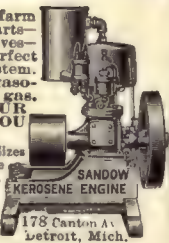


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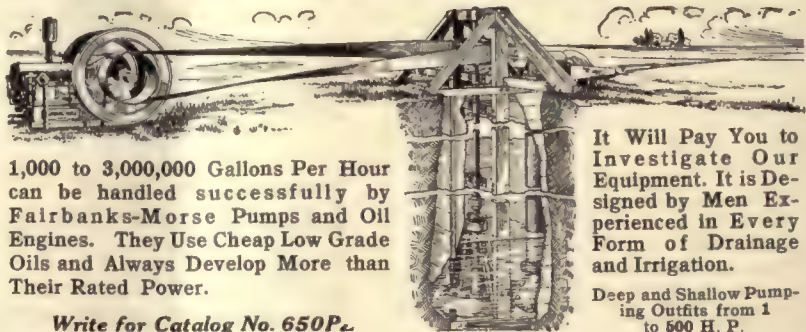
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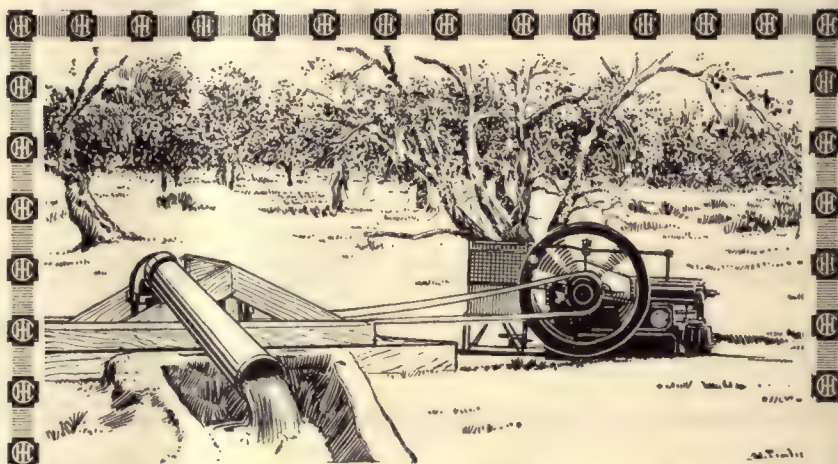
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UNDERGROUND WATER FLUCTUATIONS.

A new investigation of the supply of underground waters in southern California has lately been started by the United States Geological Survey at the request of the California Conservation Commission, which will meet the larger part of the necessary expenses for field and office work. This work serves to call public attention to the results attained in the same region by the Federal Survey through earlier work, which was begun nine years ago under the specific authority of the annual Congressional appropriation "for the investigation of underground currents and artesian wells." Five reports were issued as a result of that earlier investigation. Three of these, Water-Supply Papers 137, 138 and 139, related to the coastal plain of southern California, and a fourth, No. 142, described the San Bernardino Valley. None of these publications are now available for free distribution by the Survey, but they may be purchased from the Superintendent of Documents, Government Printing Office, at 35, 25, 25 and 25 cents, respectively. Of the fifth report, Water-Supply Paper 219, which describes the foothill belt east of Los Angeles, a small supply remains available for free distribution, and a copy may be obtained by addressing the Director of the United States Geological Survey at Washington.

This series of papers, by W. C. Mendenhall, geologist, sets forth the obvious relation between the maintenance of the supply of ground waters and the continuance of agricultural life. To measure the possible fluctuations in ground-water levels intensive studies were made and exact measurements procured. As a result of the study of several thousand wells and of the geological conditions which control the distribution of the underground waters within the area of 1,000 square miles covered by these reports, it was recognized that some parts of this area constitute separate and independent water basins, so that local conditions may cause local fluctuations not related to those of adjacent areas.

Basing its action in part on the results of this geologic investigation, Congress in 1908, created a reservation of eight sections—5,120 acres—of vacant public land within San Bernardino Valley, for general use in checking and spreading flood water and thus increasing its contribution to the underground supply. Prior to the creation of this reserve the local water companies for some years had been spreading the flood waters for the purpose of increasing the proportion of them absorbed by the sands and gravels and added to the underground supply. It is to determine the practical effects of this work that the California State Conservation Commission has asked the United States Geological Survey to undertake the present research.

To this task has been assigned as the Survey's direct representative, Mr. Charles H. Lee, who, under the direction of Chief Engineer William Mulholland, of the Los Angeles Aqueduct, through a cooperative agreement between the managers of the aqueduct and the Geological Survey, has just completed a careful study of the quantity of surface waters absorbed by the underground reservoirs of Owens Valley. These reservoirs have recently been purchased by the city of Los Angeles to augment the surface supplies available for the aqueduct which it is now constructing from a point above Independence to Los Angeles, a distance of 240 miles. A Survey water-supply paper is now in press reporting the results of Mr. Lee's intensive studies in Owens Valley.

In carrying out the investigations in the San Bernardino Basin Mr. Lee will find available the results of the earlier studies made by the Geological Survey in that basin, and these studies will be augmented by certain observations made since then by the citizens and water companies who have come to realize the significance of ground-water fluctuations as indicators of the status of the underground supplies.

For comparison with conditions in this basin where artificial means have been taken to maintain ground-water levels, there are available systematic measurements of water levels in other basins where such conservation work has not been undertaken. These comparative studies should aid in eliminating from the San Bernardino Valley problem those factors of varying rainfall and varying draft on the underground water supplies which are sufficient in themselves to account for widespread fluctuations in the water levels from year to year and from month to month.

It is expected that this latest investigation will be one more of the careful researches on the various factors that affect ground-water supplies in the Western States which

have been carried out by the United States Geological Survey within the past decade. The work done in each of the fields that have been entered indicates clearly that general statements based on isolated observations or mere reports by individuals are of no value. Careful quantitative data procured by geologists and engineers on the ground alone justify generalizations as to the upward or downward tendency of the ground-water levels, the rates of movements of ground waters, and the quantities passed into the atmosphere through capillarity, evaporation, and transpiration.

VALUE OF THE SEWAGE WE THROW AWAY.

H. C. Bradley of the University of Wisconsin, writing in the current issue of *Farm and Fireside* on saving sewage for the garden, says in part:

"One of the big problems that confronts this country is the maintenance of soil fertility. We cannot hope to go on forever taking off crops from the land and turning the sewage which those crops yield into the ocean. The phosphates, sulphurates and potassium must eventually disappear from soils which are steadily cropped, and unless the deficiency is made up the crops themselves will cease to grow. At present we make up this deficiency by stable manure and artificial fertilizers; but no one can deny that this partial return to the soil of its essential constituents is but putting off the day of reckoning to a future generation. The only permanent plan for preserving the soil fertility in this or any other country is to return to the land everything essential to plant growth which the crops themselves remove. And the only way to accomplish this is to return sewage to the soil, for human sewage is the final form to which all edible crops are brought. The ninety millions population of this country every year eliminate 90,000 tons of phosphoric acid, 90,000 tons of sulphuric acid, 90,000 to 135,000 tons of potash, 9,000 tons of magnesia, 900,000 tons of organic material, of which about 300,000 tons is valuable nitrogen in its most available form for plant-food. Of this total approximately 300,000 tons mineral and 900,000 tons organic material, a small part, is returned to the land by cesspools and similar devices for disposal, but the vast bulk of it is poured directly or indirectly through our rivers into the sea, from which we can never regain it. And such devices as the cesspool bury the material at such a depth that it becomes practically unavailable to the shallow-rooting food-desiring plants.

"The problem of soil fertility thus becomes ultimately a problem of practical sewage disposal, and we may confidently assert that at no far distant time this problem will have to be faced and solved if our land is to maintain its productiveness and increase its yield of food materials to meet the needs of a growing population."

QUICKSILVER PRODUCTION INCREASES.

The production of quicksilver in the United States in 1911 was the greatest since 1907, the total output being 21,256 flasks of 75 pounds each, valued at \$927,989, against a production of 20,601 flasks, valued at \$958,153, in 1910, according to an advance chapter on "Quicksilver for 1911," by H. D. McCaskey, from "Mineral Resources of the United States for 1911." California was the greatest producer in 1911, with 18,860 flasks, valued at \$867,749, and the remainder of the quicksilver came from Nevada and Texas. While there was an increase in the output of quicksilver last year, the amount produced was over 5,000 flasks below the average annual output of 26,609.5 flasks for the decade ending with 1911. Until Texas began production in 1899 California supplied practically the entire output of the United States for the last half of the nineteenth century.

Quicksilver is consumed mainly in the manufacture of fulminate for explosive caps, of vermilion, of drugs, of electric lighting apparatus, of scientific apparatus, and in metallurgy in the recovery of gold and silver (principally gold) by amalgamation.

The annual domestic consumption appears to have been in recent years from 18,000 to 21,000 flasks, or about equal to the domestic production. The decrease of domestic stocks and higher prices in 1911, however, caused an increased importation of quicksilver—the heaviest in many years—from 667 pounds, valued at \$381, in 1910, to 471,944 pounds, or 6,293 flasks valued at \$251,386 in 1911. On the other hand, our exports of quicksilver decreased from 1,923 flasks, valued at \$91,007, in 1910, to 291 flasks, valued at \$13,995, in 1911—the smallest export in many years.

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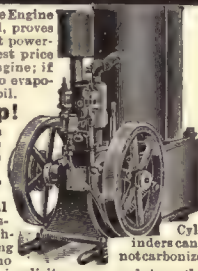
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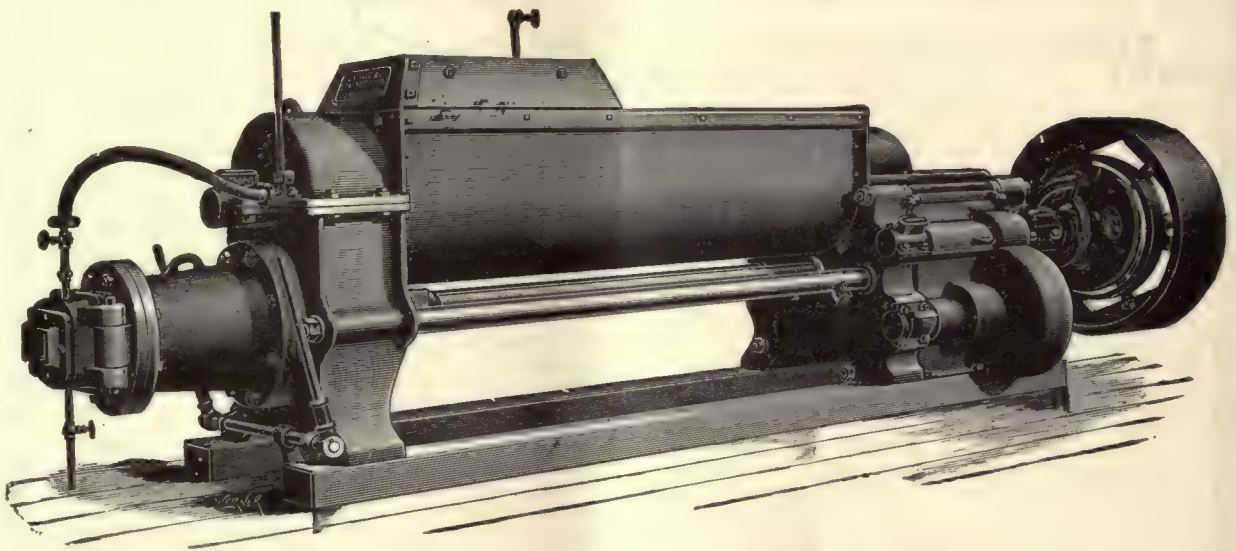
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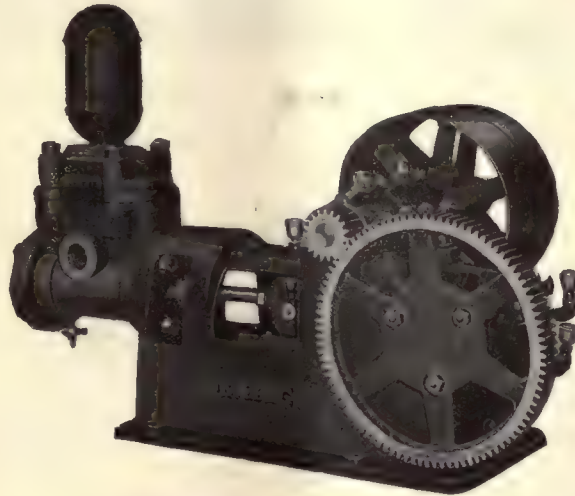
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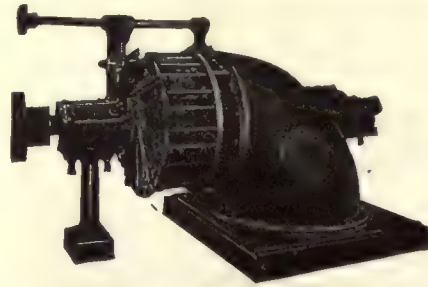


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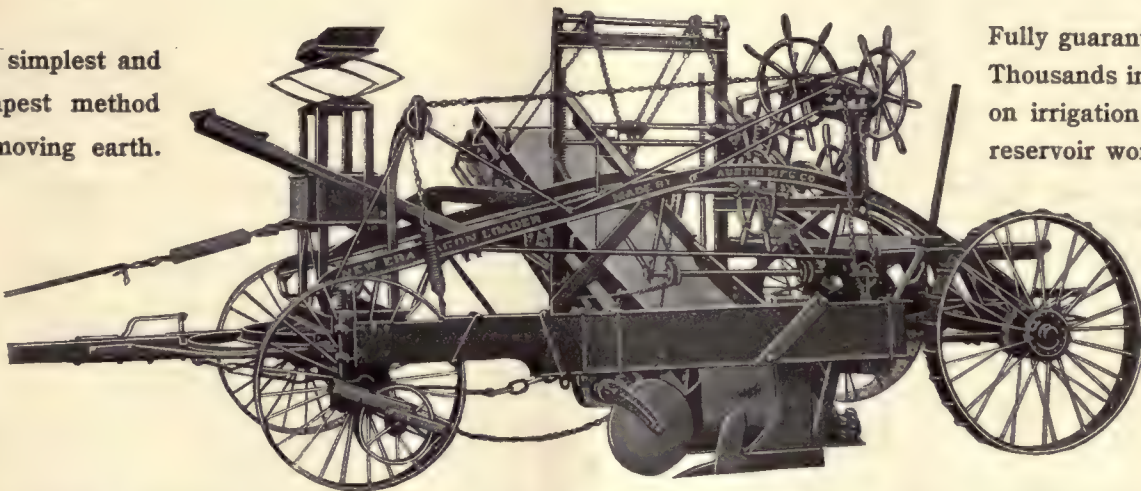
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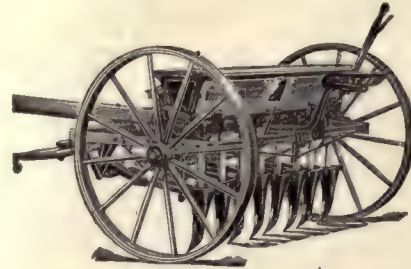
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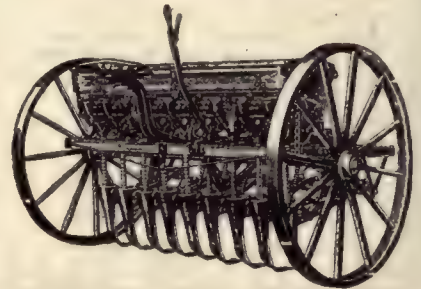
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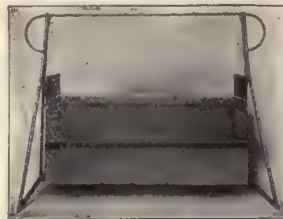


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THE IRRIGATION AGE

VOL. XXVII

CHICAGO, JULY, 1912.

No. 9

THE IRRIGATION AGE

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THE DRAINAGE JOURNAL
MID-WEST
THE FARM HERALD

D. H. ANDERSON
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30 No. Dearborn Street, CHICAGO
Old No. 112 Dearborn St.

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D. H. ANDERSON, Editor

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Lower Rates Of Interest For Farmers

American Ambassadors in Europe, by direc-
tion of the State Department, have under-
taken an investigation of farm finance to
make recommendations which shall be the
basis of legislation to facilitate the raising
of money by American farmers and eliminate high interest
charges.

President Taft, it is said, is prepared to recommend
to Congress some proposed legislation as the result of this
investigation. It may be framed after the French Credit
Foncier, which loans money to farmers at a staple rate of
interest and issues bonds for the loans. The institution is
under government supervision. The German Landschaf-
ten system also is under observation.

The American farmers are said to pay from 6 to 10
per cent interest, while the French farmer averages 4.3
per cent. The present system of farm mortgages sold to
local investors would be eliminated by the new system.

Reciprocity Looms Up In Canada

Reciprocity won in Saskatchewan by
an enormous majority. To be sure, it was
a provincial election, but it was fought on
Dominion or Federal issues and the liberal
government was returned to office with a
gain of several seats and a majority of probably three to
one.

As the whole strength of the conservative government
in power at Ottawa was used in trying to turn the tide,
the results possess unusual significance, and prove that the
sentiment in favor of closer trade relations with the
United States is very strong in that part of Canada which
is growing fastest in wealth and population.

Canadian newspapers regard the sweeping victory won by the liberal party in the Saskatchewan elections as a sign that the northwestern provinces enthusiastically favor reciprocity with the United States. The *Toronto Globe*, the leading organ of the liberal party, says that "the Saskatchewan election and the nomination of Woodrow Wilson for the United States presidency by the Democrats on a platform that includes the retention of the reciprocity offer to Canada clarify the political situation in both countries. The fight for larger markets and against taxation of foodstuffs is only begun. It will be the supreme issue in another general election."

Irrigate According To Sound Principles

It may well be said that irrigation, as a general proposition is still in its infancy, and that in 90 per cent of the projects in actual operation the application of water to growing crops by artificial methods is very crude. This is particularly the case in states and countries where the supply of water is bountiful, or the irrigable land is only partly in use or where both conditions prevail. Thus it has come to pass that a great deal more of water is used for irrigation than the land requires, or, in other words, a very low duty is obtained from the water used.

As, however, the area of land requiring irrigation keeps on growing the demand for more water becomes imperative and it is necessary that the old, crude and wasteful methods be abandoned and modern ideas, based upon scientific principles and practical facts, be substituted. It would be an interesting tabulation if the government, through its hydrographic bureau would observe the total precipitation over the entire United States and show what the average rainfall would be over this tremendous area. This would give us then the volume of the water which sustains animal and vegetable life, and which feeds the springs, lakes and rivers and replenishes the oceans. A statistical report of this nature is not published at the present time, so far as we know, but it would certainly be very interesting and useful information. It would show a tremendous volume of water which would be more than sufficient for all the needs of organic life.

It has been shown that fairly good crops can be grown in countries where the annual rainfall is as low as 12 inches, and that a rainfall of 24 inches at the proper time furnishes abundant moisture for the most bountiful crops. From these figures it may be concluded that the application of irrigation water to growing crops exceeding 36 inches during irrigation season is clearly extravagance.

A flow of water delivering one cubic foot per second will cover a square mile, or 640 acres 13½ inches deep, or 320 acres 27 inches deep in one year. However, as the irrigation season does not extend through the entire year, allowance must be made for a larger volume during such season. Thus, if the season extends over six months and if 27 acre inches of water are required per season, then the stream of one cubic foot per second in six months would cover only 160 acres to the required depth of 27 inches, thus making the duty 160 acres per second foot of water. In California the duty ranges from 120 to 200 acres per second foot, while in Utah one second foot is allowed for only 70 acres, and on some of the older projects some owners have the right to use as much as a second foot to 20 acres, which means 144 inches in four months. It is, of course, utterly impossible for the soil

or crops to use that much water in a beneficial way, and such water rights should, therefore, be set aside by law and the water which these old settlers cannot make use of should be made available for new projects which now are without sufficient water. It would be better to leave the water run idly in its bed than to apply it in excessive quantities to lands where it will cause damage by infiltration or seepage.

Another cause of waste in water is the heavy evaporation during the hot season, especially in the arid regions, and this loss may reach as high as 50 per cent of the flow. The loss from this source cannot be entirely prevented unless the water be conducted through pipes or covered flumes, which method would be quite expensive, but should be applied where circumstances will justify it.

The carrying of irrigation water in pipes or covered flumes is the ideal method where water is scarce and the maximum duty of the same is desired; it prevents losses due to evaporation and seepage, and thus utilizes every drop of the available water.

Our National Forest Reserves

A recent announcement by the Department of Agriculture states that President Taft has authorized considerable changes in the national forests by modifying boundary lines and eliminating over 200,000 acres which are restored to the states wherein they are located.

Our readers will remember that the area of the national forests reached a maximum in 1909 when they included over 194 millions of acres. This has been reduced by about seven millions of acres during the Taft administration, thus leaving still the enormous area of 187 millions of acres, equal in area of over 292,000 square miles, which is equal to the area of a square having a side of 540 miles. These forests have been practically alienated from the states within whose boundaries they are by reason of the Federal Government taking control and operating them by Federal employes.

We concede that moderate forestry reservations are a good thing and should be kept up for many reasons, but we do not think it proper that the national government should step in to control, nay to appropriate, the forests which are, and always were, the property of the various states.

We can conceive of no reason why, for instance, the state of Montana should not be just as competent to take care of and preserve the necessary forests within its boundaries than can the Federal Government, and, in fact, it could do so more effectively and at a much less expense account than can the Federal authorities. It would also give the various states, by having control of their forests, the benefits accruing from the proper use of forests in the way of timber production and grazing lands, which are now handled in a rather uncertain way.

It stands to reason that with the supervision of these forests placed in the national capital it will be impossible to satisfactorily look after all the necessary details required by the administration of such forests; and that, on the other hand, each state is best fitted to look after the forests within its boundaries. The resident population in each state is more competent to judge about its necessities than administration officers in Washington, no matter how well they may be qualified and disposed to do the right thing.

The action of the Taft administration in reducing the total area somewhat, a little over 3½ per cent, is a move

in the right direction, but it is not going far enough. There is no reason why the forest reserves should not entirely be turned back to the various states to be taken care of and administered according to wise and proper laws, which Congress or the various legislatures should pass from time to time.

Canal Rights In Dispute With England An unfortunate dispute between the United States and Great Britain over Panama canal rights has arisen in connection with the bill now before Congress. The discussion places this country in a bad light, for it looks as if a dishonorable effort were being made by our public men to ignore the treaties by which the ships of other nations were guaranteed the same privileges as those to be enjoyed by American vessels.

The United States government will have to stick to its agreement, notwithstanding a bad bargain was made. It would be desirable, and in a sense fair, to give advantages to American shipping, in view of the expense borne by this country, but it is too late now to make such a contention. In the Hay-Pauncefote treaty it was agreed that there should be no discrimination. Such an agreement seemed to be necessary at the time it was made to gain the consent of other powers to the political and commercial undertakings of the United States in connection with the canal.

We do not believe that the general trade of this country will be injured by granting equal privileges to all ships using the canal, but if there were any such fear the only honorable way to meet the case would be to revise the treaties which are now in force.

Great Britain's protest that the United States has no right under the Hay-Pauncefote treaty to pass its own coastwise vessels free through the Panama canal, while it collects tolls from British and other foreign ships found emphatic support in the Senate recently.

Opening the fight over the Panama canal bill sent to the Senate by the House, in which the free provision is an important feature, Senators Burton of Ohio and Root of New York outlined the ground upon which the enemies of free American ships will fight their battle.

Both senators declare Great Britain had surrendered important rights at Panama, held under the former Clayton-Bulwer treaty, for the pledge of "equal treatment" to all ships, given by the United States in the existing Hay-Pauncefote treaty. The controversy hinges on the question of whether the United States, in its pledge to treat the ships of "all nations" equally, meant to include vessels owned by its own citizens.

Senator Root, former Secretary of State, unreservedly declared that The Hague court would be called upon to settle the issue finally if the United States passed the bill with the free provision, which he characterized as "unjustifiable discrimination" against other nations. A decision against the United States by The Hague court, he said, would undoubtedly involve this country in the repayment of millions of dollars to the owners of foreign ships which might have been taken as tolls at the canal.

To permit our own vessels to use the canal free of charge and collect tolls from those of all other nations for a similar privilege is, of course, discriminative. And that we may do so unchallenged depends upon the construction which will be given two treaties governing this issue directly, one made in 1850, the other in 1901. The former is the Clayton-Bulwer treaty entered into with Great Britain. One section of that instrument bears directly on this issue and reads:

"It is always understood by the United States and Great Britain that the parties constructing or owning the same (the canal) shall impose no other charges or conditions of traffic thereupon than the aforesaid governments shall approve of as just and equitable; and that the same canals or railways, being open to the citizens and subjects of the United States and Great Britain on equal terms, shall also be open on like terms to the citizens and subjects of every other state which is willing to grant thereto such protection as the United States and Great Britain engage to afford."

The second treaty referred to, entered into in 1901, extended the Clayton-Bulwer provisions, as follows:

"The canal shall be free and open to the vessels of commerce and of war of all nations observing these rules, on terms of entire equality, so that there shall be no discrimination against any such nation, or its citizens or subjects, in respect of the conditions or charges of traffic, or otherwise. Such conditions and charges of traffic shall be just and equitable."

From these existing treaties, seemingly, there is an obligation upon us to deal with the vessels of other countries precisely as we shall deal with our own; to exact the same toll from both domestic and foreign vessels using the canal, or admit all free. It is true we may abrogate the treaties, and Great Britain's note will doubtless lead to a discussion which will give voice to such a suggestion; but, for all that, we can scarcely assume that position. We knew full well what these treaties were intended to express and make plain, and, certainly, there is little room to question the inference that their primary project was to prevent discrimination.

Improvement In Financial Aspect of Irrigation

There is a distinct improvement in the financial aspect of irrigation. This is chiefly due to growing confidence among capitalists and bankers. Many leading financiers are on record as predicting better times, particularly in the West.

Naturally a renewal of confidence with respect to western development will improve the prospects of all irrigation enterprises. It is not enough, however, that this improvement should be general. It ought to be direct and specific in the matter of irrigation projects.

For a long time capitalists have been discriminating against western enterprises, and irrigation has been retarded through prejudice. Financial aid has been denied many of the safest and best projects because of the unreasonable belief in the minds of Chicago and New York bankers that a large proportion of these development enterprises were impracticable or dishonest. This misinformation has been hard to fight, although western men, as a rule, know how badly founded the views of eastern bankers are with respect to the vast majority of irrigation projects.

In a sense financial men are forced into a new and friendly attitude. Time has shown that the irrigated sections of the West are the only localities that are capable of greatly increasing agricultural production. The needed increase in fruit, fodder, grain, etc., is found in the West and more especially in the irrigated regions. Furthermore, the possibilities of the irrigated lands have not been fully reached. The demonstration is sufficient to show what can be done, but the volume of production will continue to swell for many years to come, through the agency of irrigation.

The gains in agriculture, which the West shows, and

which are impossible in a country lacking the regulation of soil moisture, appeal to the common sense of the world at large. Bankers know that agricultural production must be increased by some means, and they see that irrigation is the only sure means of which civilization has any knowledge. It is not to be wondered at, therefore, that sentiment is changing in the financial centers, and that the outlook for irrigation and all western development work has improved.

While Europe has been helping her agriculturists and promoting their enterprise for more than seventy years, by means of ample and cheap credit or money accommodation, we have done absolutely nothing for our western farmers in a similar way. Although we knew that they are the guardians and producers of our permanent wealth, we have left them to administer that trust with never a special effort to give them access to money or credit, cheaply and certainly, as we should have done and as Europe has done. We were only interested in what we could get out of them, and selfishly left them to their fate in financing their own requirements. So, to our egotism we add selfishness—two national attributes we fain would dispense with.

That we did not lack precedents to alter the rural credit situation in this country may be seen at a glance from the following statistics: Germany has not less than 18,000 financial institutions to assist farmers and workmen, 10,000 of which are purely rural. During the year 1910, the total business transacted by these concerns amounted to \$1,500,000,000. Austria operates 4,000 "popular" banks; Belgium, 300; Italy, 7,000; France, 5,500, and Hungary, 700. England has recently introduced them with every prospect of their success. Through the loans made to farmers by these credit associations, agriculture and its votaries in Europe have thriven amazingly.

The day of excessive interest rates has passed, for the essence of these banks is to give borrowers "cheap" accommodation. Farmers with empty stalls, through this assistance, now own large herds. Their home life has been improved, their fortune has been started, their productive energy has been quickened, and their profits have been considerably enlarged.

Probably in a year or so we will look into the establishment of similar institutions to benefit farmers in this country, for a senatorial committee is now gathering data to that end.

There is an educational impulse in connection with the coming opening of the Panama canal, which also will help all worthy western enterprises. It is apparent that the trade expansion in the far west is largely due to the canal. The soundness of western enterprises has long been appreciated by the few, and from this on it will be known to the many.

LARGE PROFITS IN POTATOES.

All progressive farmers who can bring their plans into the right shape are going ahead with potatoes. Prices continue on a high level and the market demand is so keen that foreign producers are making large shipments to this country. If American farmers are wise they will control this market and reap the big profits which are to be gained from potato culture.

The fact should be kept in mind that the proper kind of cultivation will give a yield of about 200 bushels per acre, whereas the average in this country is under 100 bushels. The yield in parts of Maine as well as in the Northwest often runs upwards of 200 bushels, while in Germany it is close to 200. England and Ireland fall a little behind Germany. For nearly two years now the price per bushel to American farmers has been \$1 to

\$1.50 where they have sold to private customers and 75 cents to \$1.25 when shipping to commission men. It is well to compare this price and yield to wheat figures. In raising the grain farmers are in great luck if they secure 20 bushels per acre and receive \$1 a bushel.

Potatoes do not require the richest of soils. They will thrive in a sandy loam. Soggy land is bad for the crop and if any such has to be used it ought to be drained. Regular moisture in light quantities on any ordinary farm will insure a good crop of potatoes. An irrigated farm has advantages over any other, but where the rainfall is insufficient a dust mulch should be kept around the growing crop for the purpose of conserving such moisture as there is. It is unwise to let potato ground harden and bake in the sun. By giving reasonable attention to the product along the lines indicated success will be attained in almost any section of the United States. Potatoes do well in rotation with clover, millet, corn, beets, rutabagas, cabbage, etc. It is feasible to dig a crop of early potatoes in June or July and then immediately sow millet, rye or fodder corn on the same ground. It is also a good plan to plant late potatoes on land from which clover, cowpeas, rye or any other early crop has been taken.

There are sixteen states in which the cultivation of sugar beets is already well established in this country. Practically all of these states are large producers of potatoes. More significant still is the fact, recently brought out by an exhaustive inquiry, that the use of sugar beets in rotation with potatoes, corn, wheat and other crops increases the yield of every one of these crops from twenty-five to fifty per cent. In the case of potatoes the increase was 46.2 per cent.

Early 'Rose, Triumph, Early Michigan and Early Ohio remain standard early varieties, while some of the best late ones are Burbank, Peerless, Peachblow and Green Mountain. There are many variations in these types, but for all practical purposes the potatoes can be recommended as named above.

It is necessary to be on guard against disease and insect pests. A healthy growth of potatoes can hardly be expected on soggy land or where spraying is neglected. Good seed is of the highest importance, and with this point settled thorough cultivation will insure a crop five years out of six. The sulphate of copper solution is perhaps the best all-around article for warding off disease and pests, as well as for prolonging growth in order to get good-sized tubers. If something further seems to be needed in fighting insects paris green will be found effective. The standard varieties resist disease better than any others, and it is unwise to experiment with imported potatoes, or those about which little is known.

Potatoes are so hardy that they are raised to advantage in the most northerly states, and even in Siberia and other cold countries. Seed produced in the North will show good results in Southern states, but this is a rule that will not work both ways. Tubers originating in a semi-tropical climate have to be acclimated in the North before returning satisfactory crops.

THE POTATO.

Doubleday, Page & Co., of New York, have brought out a volume which is easily the best work ever published on the subject of potato culture. The book was written by Eugene H. Grubb and W. S. Guilford, who are instructive writers and acknowledged authorities on all such matters.

More pounds of potatoes are produced than of any other food crop in the world. In 45 bushels of potatoes, which would be a light yield for an acre, there are 2,700 pounds of food, while in 14 bushels of wheat, a fair average for this grain to the acre, there are only 840 pounds.

This able volume proves several important things. The first is that the potato is one of the most profitable crops that any farmer can raise. Another is that the food value of the product is underestimated. It is also shown in a most comprehensive way that potatoes come to their greatest yield and highest perfection in regions which enjoy a regular supply of moisture—preferably a regulated supply. Hence, this is an ideal crop for irrigated lands.

Doubleday, Page & Co. will send the potato book on receipt of \$2, and we have no hesitation in recommending it as the most complete and authoritative work ever published on the subject.

OFFICIAL CALL

TWENTIETH NATIONAL IRRIGATION CONGRESS

To the People of the United States, Greeting:

The National Irrigation Congress will hold its twentieth session in Salt Lake City, Utah, September 30, October 1, 2 and 3, 1912.

The session will open at 10:00 o'clock Monday morning, September 30.

BIRTHPLACE OF THE CONGRESS.

It is fitting that this important agricultural and industrial development agency should meet this year in Salt Lake City, the center of that splendid empire which irrigation has reclaimed from the Great American Desert.

Here its first meeting was held twenty-one years ago, September 15 to 17, 1891.

Here, also, was the birthplace of Anglo-Saxon irrigation.

PERSONNEL.

The personnel of the National Irrigation Congress will be as follows:

The officers of the Congress.

The President of the United States.

The Vice-President of the United States.

The Members of the Cabinet.

Members of the United States Senate and House of Representatives.

Governors of States and Insular Possessions of the United States.

Members of Federal, State and Insular Irrigation, Water and Conservation Commissions.

State Engineers and Commissioners of Agriculture and Horticulture.

The Mayor of each city or town having a population of over one thousand.

Executive Committeemen, Honorary Vice-Presidents and Members Board of Control.

Chairmen of general and special committees.

Permanent delegates.

DELEGATES.

Delegates appointed under the provisions of the constitution as follows:

Fifteen delegates appointed by the governor of each state or territory.

Ten delegates appointed by the mayor of each city of more than twenty-five thousand population.

Five delegates appointed by the mayor of each city of less than twenty-five thousand population and over one thousand.

Five delegates appointed by the chairman of the governing body of each county.

Two delegates appointed by the mayor of each incorporated town having a population of less than one thousand.

Two delegates duly accredited by each regularly organized association devoted to Irrigation, Agriculture, Horticulture and Engineering.

Two delegates duly accredited from each college and university.

Two delegates duly accredited from each commercial body and club concerned with public interests.

EARLY ACTION IMPORTANT.

Appointment of delegates should be made as early as possible to facilitate the organization of state delegations. Notices of appointment giving full name and postoffice address of each delegate should be forwarded to the secretary of the National Irrigation Congress at Salt Lake City.

PERMANENT DELEGATES.

While the policy of the congress is shaped at each session by the state delegations, the continuity of the organization and the efficiency of its work are influenced by the permanent delegates provided for by Article VI, Section 2 of the constitution; and members interested in the permanency of the congress are earnestly invited to become permanent delegates.

FOREIGN REPRESENTATIVES.

All foreign governments have been invited to send representatives to the congress.

The hearty response from foreign governments at previous congresses has made the foreign representation an important feature of the organization. The increasing interest promises large representation this year.

VISITORS.

The presence of visitors, including ladies, is specially appreciated and their attendance is invited.

PROGRAM.

The National Irrigation Congress—the most practical, upbuilding and unselfish organization in the United States—advocates and will discuss:

Irrigation of the Great West.

Storing of the floods.

Measurement of streams.

Scientific investigation of irrigation projects.

Proper safe-guarding of irrigation securities.

Enactment of practical working and uniform state irrigation laws.

Preservation of the forests.

Opportunity to build new homes.

Heeding of the call of the manless land for the landless man.

Elimination by law of fraud and connection with the locations and sale of land.

Co-operative effort of government and state immigration officials.

Close co-operation of state engineers.

Etc., etc., etc.

The ablest speakers of this and other lands will discuss these vital questions. It will well repay your attendance and attention. Free discussion is an important feature of the congress and will be encouraged.

COME—HEAR—SEE.

Stupendous illuminated parade Monday night, September 30. Pageant of the mighty wizard of the Wasatch Presentation of the Irrigation Queen.

Rendition of the Irrigation Ode in the famous Tabernacle under the personal direction of its composer, Professor John J. McClellan.

Mammoth exhibit of irrigated farm products.

Big exhibition of minerals—livestock—racing contests.

Annual fair of the state of Utah, September 30-October 5.

Semi-annual conference of the Mormon Church, October 4-6.

SPECIAL RAILWAY RATES.

Special railway rates and tourist fares will be available on all lines. Delegates should particularly notice the opportunity this trip will give to visit numerous places of national interest.

INFORMATION.

Salt Lake City has the best of hotel accommodations and every attention will be given visitors and delegates by the good people of Utah. Make your reservations early.

Information relative to the congress program, railroad and hotel rates and other data will be furnished upon request from the office of the secretary, 324 Boston building, Salt Lake City.

You are invited to join in the great constructive work of the congress.

Salt Lake City, Utah, July 29, 1912.

THE TWENTIETH NATIONAL IRRIGATION CONGRESS,

FRANCIS G. NEWLANDS,
President.

ARTHUR HOOKER,
Secretary.

The Executive Committee,
G. RICHARD W. YOUNG,
Chairman.

The Utah Board of Control,
GEO. A. SNOW,
Chairman.

HELPING OUT THE RAINFALL

By Dr. A. C. TRUE

Director United States Office of Experiment Stations,
Department of Agriculture

The severe drouths of the past two seasons over wide areas in the states east of the Mississippi River have severely curtailed crop production and brought serious losses upon vegetable and fruit growers. There is, therefore, great interest in that region in learning about irrigation and in adapting the methods of applying water which have proved



so profitable in the West, to the agricultural conditions in the eastern half of the United States.

In Europe the value of irrigation as a supplement to rainfall is well known, and extensive irrigation works have been built for this purpose, beginning as far back as the twelfth century. In Italy, for example, large sums of money have been spent in the construction of permanent irrigation reservoirs and canals, and irrigation has for a long time been profitably employed in regions where the total annual rainfall amounts to 40 inches, but where the rain often falls at irregular intervals, so that the crops would suffer without irrigation.

In the United States irrigation is extensively used in the humid region in connection with rice growing. This is chiefly done in Louisiana and Texas, but more recently has been extended to the lowlands of Arkansas. There the land had first to be drained in order that the wet and soggy prairie might be prepared for cultivation. Then wells were sunk, pumping plants installed, and the water spread out over the fields through a regular system of irrigation. Lands which formerly had practically no value, though their soils are very fertile, are yielding abundant crops by this combination of drainage and irrigation. The cranberry industry of Massa-

chusetts and New Jersey is wholly dependent on irrigation. The cranberry bogs must be leveled, covered with sand, drained and irrigated in order that we may have cranberry sauce with the Thanksgiving turkey.

Aside from this, irrigation is at present used only here and there in the humid region, but the practice is steadily spreading. The rainfall of Florida is from 40 to 70 inches, but practically all the water falls between April and October. The growers of early vegetables and citrus fruits in that state have, therefore, in many instances found irrigation profitable. The celery growers at Sanford, Fla., are successfully practicing a system of subirrigation from drain tiles. The water is obtained from flowing wells having their origin in Lake Monroe, which is an enlargement of the St.

Johns River. To install such a subirrigation system costs from \$85 to \$125 per acre. But lands in this region, which in their natural state are of no value, when irrigated and drained will produce celery worth \$2,000 per acre for a single crop. Similar results have been obtained from irrigating lands in other parts of the state which are devoted to the growing of citrus fruits.

At Albany, Ga., large crops of alfalfa have been grown with irrigation on worn-out cotton lands, and three times as much corn has been produced with irrigation as was grown in adjoining fields without irrigation. In the midst of plantations desolated by the old-time system of continuous cotton growing, there is now, near Selma, Ala., an irrigated tract which is highly productive. In this region are many flowing wells. The waters of one of these, which for nearly half a century had been wasted, are today running in an irrigation ditch and coining money for their owner.

The desirability of irrigation in such a region is conclusively shown by the weather record kept at Selma. This shows that in the growing season from March to November during ten years (1900-1909) there were sixty drouths from fifteen to over fifty days in duration. At Columbia, S. C., the records for the same period show sixty-two similar drouths, and those at Vineland, N. J., show forty-six drouths.

Speaking to the Farmers' Demonstration Society at Vineland, Dr. Samuel Fortier, Chief of Irrigation Investi-



View of Plot Irrigated by Sprinkler System from Porch of Residence of Granville Leeds, Rancocas, N. J., Who Has Found Irrigation Profitable in Raising Vegetables and Strawberries.

Note.—The illustrations for this interesting and instructive article have been furnished us by "Popular Mechanics," which today is, without a doubt, the most widely read periodical on practical mechanics, and thus is fully deserving of its title of "Popular Mechanics." It is written so clear that anyone can understand it and everybody interested in mechanical arts should read it.

gations of the U. S. Department of Agriculture, said:

"If the land of Southern New Jersey is to be farmed in the old way, it is questionable if irrigation is either necessary or desirable. The small revenue annually received from the land would scarcely pay for the extra water. On the other hand, if the lands should be farmed in accordance with the latest scientific methods, irrigation during dry spells will become a necessity for all crops having a gross valuation of from \$50 to \$250 and over per acre." Subsequent experiments in this region have shown the truth of this statement. During the past season the yield of alfalfa at Vineland was increased by irrigation at the rate of two tons of cured hay per acre, worth \$20 per ton in the field. The value of the strawberry crop at one place in that region was increased this year \$100 per acre, while the early strawberry crop, without irrigation, was a total failure. The department's irrigation expert estimates that the saving of a single year's strawberry crop by irrigation would pay two or three times for the most expensive spray-irrigation system.

In the East the farmer or horticulturist will have to study carefully the sources of his water supply, the location and soil of his fields, and the character and value of his crops before undertaking the practice of irrigation. In some localities there are streams which may be inexpensively utilized for irrigation; in others water may be economically pumped from wells or ponds. If the land is level or slopes evenly and the soil is sufficiently retentive of moisture, surface irrigation may be employed in accordance with the



The Source of Water Supply for Irrigating Mr. Leed's Farm. The Power Plant Before It was Housed In. A Comparatively Inexpensive and Ever-Ready Means of Securing Water.

common practice in the West. In level lands with a shallow, porous soil, subirrigation through tiles or pipes may sometimes be used for shallow-rooting crops having a high market value.

Irrigation by spraying is already used to a considerable extent on lawns and gardens, and about residences, and by market gardeners and florists having valuable plantations where drouth, even for a short period, will seriously reduce the market value of the crop. An overhead spray system devised by an Ohio man, and first used by him in greenhouse irrigation, has more recently been found well adapted to the irrigation of outdoor truck crops.

In this system a main feed pipe is laid across the end or through the center of the field. Along this pipe, at intervals of 50 to 60 feet, standpipes are set up, each feeding a lateral pipe line supported on posts at an elevation of 7 feet above ground. These laterals run parallel across the field. In the shell of each lateral pipe are screwed small brass nozzles 4 feet apart, and all located on the same side of the pipe. Each nozzle throws a fine, straight stream of water. The pipe is so supported on the posts that it can be revolved on its bearings, and thus the water can be thrown to any desired location in the lateral's zone. The irrigator has complete control of the water and can make up small or large deficiencies of rainfall with comparatively little labor. The amount of water needed at one time to irrigate such crops as onions, celery or lettuce is quite small but very important to their



Irrigating a Strawberry Patch. This System Extends Over Five Acres at Rancocas, N. J. Nozzles Every Four Feet on Lines Fifty Feet Apart. The System Distributes 250 Gallons of Water a Minute.

continuous growth. Delicate plants may be set out at any time and made to grow by frequent light irrigations.

In Michigan, Wisconsin and Minnesota there are many localities where irrigation will ultimately be used for truck crops, fruits, sugar beets, etc. In this region there are numerous lakes and streams from which water may be brought to the fields by the use of small pumping plants. The short growing season in these northern latitudes makes it very important that the crops have a continuous growth, especially such as are easily damaged by frost. The weather records at Oshkosh, Wis., show that twenty-seven drouths of from fifteen to fifty-nine days occurred in ten years, and more than half of these came in the spring and

and early summer. In the spring of 1910 market gardeners and fruit growers in Wisconsin suffered severe losses from prolonged drouth. When the rain came late in the season, plantings were made at the same time over large areas, with the result that many crops matured together and an overstocked market reduced prices to an unprofitable level. A later drouth the same season ruined a celery crop valued at \$1,000 per acre which was growing on peat lands near Waupaca, Wis. In that locality there is plenty of water within a few feet of the surface. The profits from a single year's crop would more than pay for a pumping plant and the cost of irrigation.

At Neenah, Wis., one and one-half acres of strawberries yielded fruit valued at \$200 after the non-irrigated vines in the same field stopped bearing for the season. An onion crop grown under irrigation at the same place yielded bulbs at the rate of nearly 500 bushels per acre, which took first premium for quality at the 1911 Winnebago County fair in Wisconsin. This crop was irrigated six times during June and July, and received 3 inches of water by irrigation and about 6 inches by rainfall. The rain, however, came in one large storm and eleven small showers, none of which moistened the soil to a sufficient depth. Irrigation is already used to a considerable extent in Wisconsin in connection with the growing of cranberries.

Further south in the great agricultural states of the Mississippi valley the possibilities of irrigation are relatively small. In Iowa, Illinois, Ohio and Indiana the rainfall is

quite evenly distributed over the growing season, and the soils, when thoroughly cultivated, retain moisture in relatively large measure. Grain growing and animal husbandry are the great agricultural industries of this region. Grain and forage crops suffer relatively little from short drouths and it would not pay to irrigate them. At Ames, Iowa, for

example, during ten growing seasons there were twenty-three drouths of fifteen days or over, with less than 1 inch of rainfall. But even in these dry periods small showers frequently occurred which helped to keep the air humid and also to check evaporation from the soil.

In the eastern part of the great plains, where the rainfall is not large,

but ordinarily sufficient to mature crops, there are many localities where irrigation could be profitably used to raise the yield of field crops or to promote the growth of trees, vegetables, fruits and ornamental plants in orchards and gardens and about the homestead. As the farmers in this region accumulate capital they will undoubtedly resort more and more to irrigation as a means of increasing their income, securing more of the comforts of life and making their home surroundings more attractive.

The same thing is true of the Pacific Coast. In the beautiful and fertile Willamette valley in Oregon, for example, while the annual rainfall is abundant, there is a long dry period in the summer. Many crops which would grow best at this season are greatly hindered by drouth. The agricultural experiment station at Corvallis has been studying this problem in co-operation with the Department of Agriculture and has already demonstrated the usefulness of irrigation for alfalfa, clover, potatoes and other crops. Business men in Portland, Ore., have become so well convinced that irrigation in Western Oregon is profitable that they are now developing a large irrigation project near Salem. Vast areas in the Sacramento and San Joaquin valleys in California were for many years farmed without irrigation. But after long hesitation and much active opposition the great wheat farm-

ers adopted irrigation as a profitable insurance against drouth and, once convinced of its benefit, spent millions of dollars in developing and managing irrigation systems.



Irrigating an Orange Grove by



Taking Water from Hydrant Into Furrows. An Easy Means of Regulating Flow.

Open Ditches, at Orlando, Fla.



Potatoes on Irrigated Land at Corvallis, Ore. Water is Pumped from a Creek with an 18-Foot Lift by a Gasoline Pumping Plant. The Result is a Very Profitable and Sure Crop.

Their experience will doubtless be repeated in many regions in the United States as increasing population and more complete utilization of our agricultural lands raise the price of land and extend the market for high-priced crops until the cost of installing and running irrigation plants will be amply repaid by the increased yields per acre which irrigation is sure to bring. In response to considerable present demand for information along this line, and in preparation for the great future of irrigation in the humid region, the irrigation service of the Office of Experiment Stations of the Department of Agriculture is making a broad study of the irrigation requirements and possibilities of different regions and is seeking to discover the most economical and effective methods for the utilization of available water supplies for this purpose.

A large share of the future agricultural prosperity of the United States will depend on the reclamation through utilization of land through drainage and irrigation. Development in both these lines should go hand in hand.

FORESTRY TOPICS.

"Good roads have an important bearing on forest fire protection," says State Forester Cox of Minnesota. "They not only give the state force a way to get in the forests but make it easier to get help in fighting the fires. The proposed International Falls — Twin City road will divide the northern part of the state into two forest regions, and can be used as a fire break to protect either one of the sections in case the other one is fired. The forest law of 1911 makes it necessary for all slashings and other

débris to be disposed of. This is being done in all construction work and the Elwell roads which will go through this section will give the forest service effective fire lines."

It is the hope of the forest service that several great trunk roads be built in the Northern part of the state with laterals running to them. Several roads are suggested by Mr. Cox as being of great value to the forest service.

Announcement has been made by the State Board of Forestry that there will be sixty-five men appointed in Oregon under the \$10,000 appropriation received from the government through the Weeks law, these men to work in Oregon in patrolling the headwaters of the navigable streams of the state.

The State Board of Forestry also made announcement of completion of its manual and handbook for fire wardens in which the general policy of the Board for this year is largely announced.

In the appointment of the men under the Weeks law there will be about fifty-seven of the men stationed west of the Cascade Mountains and the other eight will be placed east of the mountains. It was the intent of the law to protect the headwaters of navigable streams and the main navigable streams are west of the Cascades. The men west of the mountains will be apportioned from one to seven in various counties, according to the size of the counties, the quantity of the timber involved and the nature of the streams arising in the respective counties.

The work of reforestation is being carried on at a good rate in the state of New York.



Alfalfa, Clover, Corn and Potatoes on Irrigated Land at Corvallis, Ore. Excellent Results Were Secured on all Except Corn. The Annual Rainfall at Corvallis is 45 Inches, but it is Dry in Summer.

SOUTHERN IDAHO IRRIGATORS

What the Forty-Acre Farmer is Doing in the Twin Falls Country, Idaho.

By Herbert Shearer

This year I finished my Pacific Coast trip by making a final stop in southern Idaho. I wanted to know from personal observation if the progress in this irrigated section could possibly have been as rapid as indicated by the stories I had heard.

People living in the Twin Falls country often indulge in such expressions as, "Seven years from sage brush and jack rabbits to a prosperous farming community where 90 per

a furrow, keeping pace with farmers from the older sections of the United States. In some instances I thought the city man was having the best of it. Some of them were farm boys who went to the city, learned business methods through close competition and carried their knowledge with them back to their irrigated farms. Their business training supplied what some farmers are deficient in.

On raw land the general plan is to remove the sage brush in winter, plow in early spring and sow oats, putting in alfalfa seed at the same time.

This plan gives a crop of oats in four months. After the oats are cut the alfalfa is irrigated and immediately springs up and grows rapidly. It is ready to cut for hay four weeks after the oat harvest.

Two crops from the same land within six months of sage brush was a new proposition to me. Of course, it meant work and plenty of it. Besides removing the sage brush the land was graded for irrigation and corrugated to lead the water



HOME OF J. A. WATERS, NEAR TWIN FALLS, IDAHO.

No Region Excites Greater Interest than this in the Minds of Those who are Looking for the Best Results Under Irrigation.

cent of the land is producing valuable farm crops and the farmers are living in comfort and luxury."

This sounds like a fairy story, but it is not putting it too strong. In less than a week I had made up my mind that the most optimistic reports of this wonderful irrigated section were all truth and a yard wide. Local historians informed me of the time when the water was turned on from the ditches. The development today shows the progress of five years on the south side tract and three years on the north side of the Snake river.

The Twin Falls section is peopled by native Americans. There are a few foreigners. Former city and rural residents have taken up their abode as farmer-neighbors and are prospering together. I found city men who had never plowed

in the right direction. The land in every part of the tract shows that good work has been done.

Before driving out to see the farms I had driven pretty well over the city of Twin Falls and had wondered what built up such a thoroughly substantial town in the short space of six years. When I saw the farms and realized that each acre is producing annually from \$20 to \$100 worth of grains, alfalfa and other farm produce, the question was answered. With a thickly settled farming community of money-makers, the support of a lively distributing center like Twin Falls is assured, not only for the present, but for all time to come.

I traveled hundreds of miles on the main line and branches of the Oregon Short Line Railway. The road is a

good one, well equipped with modern rolling stock, and it is busy. I was informed that the road increased its business 300 per cent last year, which was principally due to the production of farm crops on Idaho irrigated lands.

The week before my visit to Twin Falls a carload of strawberries was shipped to Wichita, Kan. It was an experiment. The day I left Twin Falls a telegram was received stating that the berries sold for \$2.40 per crate. After deducting the freight and selling expenses, the net returns to the growers was \$1.74 per crate, a very satisfactory price to the growers.

The growing of strawberries in the Twin Falls section as a garden product has been tried out satisfactorily every year, but this is the first time that berries have been produced in quantities sufficient to ship by the carload.

The climate is especially adapted to growing fruit. Dry weather at blossoming time is the rule and this permits perfect pollination. Absence of rain during the growing season insures clean fruit, while the dry atmosphere prevents the development of fungus diseases which have proved so destructive in the east.

While I was driving amongst the farms alfalfa stacks were growing by the hundreds like mushrooms. Last year the farmers cut so much alfalfa they were afraid of having a surplus left on their hands. Buyers heard of this difficulty and shipped out so much that the horses and cattle at Twin Falls were placed on short rations last spring. This year the farmers are planning to feed more stock and keep a better supply of alfalfa hay at home.

Hundreds of apple orchards in the Twin Falls country are just coming into bearing. I walked through these orchards day after day, noting the thrifty growth and the formation of young apples on trees that were old enough to bear. In almost every instance the trees averaging ten feet in height were well set with fruit. None of these orchards were more than six years old.

A good many apple orchards are planted with the trees 30 feet apart each way, with peach trees between in the rows, thus spacing the trees 15 feet apart one way and 30 feet apart the other way. The wide rows are planted between with corn, potatoes or beans. There is room for seven rows of potatoes. The yield is usually very satisfactory, while the quality is the very best. Idaho potatoes made a record last winter in Chicago, the quality being superior to any other potato on the market. The price of Idaho potatoes in Chicago last winter was about 2 cents a pound.

Farmers in Idaho told me of yields ranging from 300 bushels to 500 bushels per acre when planted as a field crop. Orchard planting never covered the whole ground, as space had to be left for cultivating and irrigating the trees, but in many instances potatoes in the orchard paid for all the expense of caring for the trees, besides leaving a handsome profit.

Easy payments have made it possible for men of limited means to buy land. I found a number of men who had used almost their last dollar in making their first payment and moving to the land. In such cases they managed to grow a crop of some kind, the women looking after the garden and the men securing employment in the neighborhood. By close economy they managed to get through the first year with a store of good health, energy and determination which counted splendidly toward the second season. In every such case where the families stuck and worked they have won out and are now living in plenty.

At the time of my visit cherries of the sour varieties were just ripening, the most popular being the English Morello and Early Richmond. The trees were loaded, although some of them had been planted but three years.

It reminded me of the sour cherries of New England that every farm wife puts up in glass jars for winter use, and the taste of pickled cherries on those farm tables carried my memory back to the days when I was always hungry for such delicacies.

My prediction is that fruit canneries will soon be a commercial enterprise of great importance. There are good business openings along this line.

The growing of alfalfa in such abundance is turning the attention of farmers to dairying. Every morning cream wagons may be seen on their way to the creameries. On general principles, if alfalfa be worth \$7 per ton to sell, it is worth \$14 to feed to dairy cows. Getting the cash each month is also a great advantage.

Alfalfa meal mills are being built so that much of the alfalfa crop will be shipped this year in this condensed

form. Alfalfa meal is worth as much as wheat bran. Chemical analysis shows the composition to be about the same and feeding tests clinch the proof. From \$28 to \$36 per ton is paid for Idaho alfalfa meal in eastern markets.

In the Twin Falls country alfalfa is cut when the first blossoms appear, when the full quota of sap is in the plant and before the stalks get woody. Every day is hay weather, so there is no waiting for the clouds to clear away. Alfalfa hay, cured under such conditions, goes to the grinder looking as green as when it stood growing in the field. Alfalfa meal made from such alfalfa is worth several dollars per ton more than the ordinary and eastern feeders are finding it out.

Sometimes the new settler in his hurry to get started sows alfalfa without carefully preparing the ground. In such cases the alfalfa is plowed under after it has grown a year or two and the land is again seeded to oats. I have seen photographs showing oats as high as men standing in the grain when grown on alfalfa ground. The reason for this is that the alfalfa plant collects nitrogen from the air and deposits a surplus in the soil. Nitrogen is the driver in plant growth. It is the most expensive fertilizer and the most elusive. It is the first element to escape from barnyard manure and commercial fertilizers. Farmers who grow alfalfa never worry about the nitrogen problem.

Alfalfa is the only farm crop that can be grown extensively that will return large profits and improve the soil at the same time.

Every farmer in the Twin Falls country feels happy and secure in the splendid water supply that runs continually in many of the ditches ready at any time to be turned into the farm corrugations to water the trees and general crops.

1912 BUDGET FOR DENVER & RIO GRANDE RAILROAD.

Vice-President Brown of the Denver & Rio Grande Railroad has just given out particulars regarding the 1912 budget.

The gross expenditures will approximate six million dollars, of which two and one-half millions will be spent for equipment and the balance on double track and improvement of terminal facilities.

During the past week orders for sixteen Mallet compound locomotives of the articulated type were given the American Locomotive Works of Schenectady, N. Y., and the Baldwin Locomotive Works of Philadelphia received an order for fourteen Mikado type freight locomotives. An additional order for six passenger locomotives will be placed within a few days and also a contract for seven hundred box cars, three hundred and fifty coal cars, one hundred stock cars, and fifty cabooses.

A contract for nine miles of second track between Castle Gate and Kyune, Utah, has been given the Kilpatrick Bros., of Beatrice, Neb. With this stretch completed, Denver & Rio Grande will have a continuous double track line from Helper to Tucker, Utah, a distance of thirty-three and two-tenths miles. Ten thousand tons of eight-five pound steel rail will be used in relaying track at various points during the coming summer. A large sum of money has been appropriated for improving terminal and junction point facilities and much side track will be added during the present summer.

Surveyors are at work permanently locating a new 2 per cent line to take the place of the present 4 per cent grade on the west side of Soldier Summit in Utah. Bids for this work have not yet been asked for, but on completion of the survey, it is anticipated that they will be.

CORRESPONDENCE.

Chicago, July 23, 1912.

To the Editor, IRRIGATION AGE, Chicago, Ill.

Dear Sir: I have looked through the library for a description of the Skinner system of irrigation, and do not find any. If there is such a system I would thank you very much for a description or citation where it can be found, as I am interested in sub-irrigation, and oblige,

Yours very truly,

CHARLES CARROLL.

Are any of our readers familiar with either the Skinner or any other system of sub-irrigation. If so, will they kindly communicate with the Irrigation Age, giving such information as may assist Mr. Carroll.

SUBSCRIBE NOW!

No one interested in Irrigation can afford to be without THE IRRIGATION AGE: 480 pages of reading matter per year for only One Dollar.

BUSINESS DISREGARDS POLITICS

By C. C. Bowsfield.

Two of the most turbulent political conventions ever witnessed, with an aftermath of controversy and uncertainty, have failed to disturb business. Such a disruption of affairs as occurred in the national party gatherings would have been sufficient a dozen years ago to shake the country to its foundations. A steady improvement in trade during the last two weeks shows how completely financial interests are disregarding politics.

Whether it is a mistake or not, this nation is committed to a material reduction of the tariff, and business men who are directly concerned with imports and changing schedules have discounted the possible effects of a general revision. But while we may feel sure that a reduction of duties is coming, the country is still a long way from free trade. Even Democratic success in November would not insure a removal of the entire protective tariff. Changes will be made along conservative lines, no matter what the platforms demand and the campaign orators promise.

Therefore a feeling of confidence has been maintained in business circles despite the political agitation and unrest. At the same time a cautious spirit is manifest, which reflects increased sagacity and wisdom on the part of investors. There is ample evidence of underlying soundness in trade conditions, and this is kept in mind by financial houses in the face of extraordinary political excitement.

One of the most significant facts is that trade is expanding steadily if not rapidly in the hands of people who have become conservative through recent experience. All investments are being more sharply scrutinized than ever before, and this serves to curtail speculation in unimproved land as well as in all property of uncertain merit. Such a feeling and such a condition make for commercial stability.

The calmness which prevails among business men as the national campaign develops intensity of feeling will receive various explanations. It is reasonable to assume that alterations in the tariff schedules which may be looked for at the hands of which ever party has the responsibility of government in the immediate future will have comparatively little effect on business. This is accounted for in part by the fact that manufacturers and importers of merchandise have been operating close to bed-rock in the last two or three years and have no extensive accumulations of goods which might be seriously affected by changes in duties. There is a partial explanation also in the fact that the cost in Europe of producing all commodities is a little higher than it has been and is somewhat nearer the American level than in the past. By reason of improved facilities of manufacture and easy money in this country, with unusual firmness of interest rates abroad, many lines of our own merchandise can be placed on the domestic market at lower prices than were current a few years ago.

In addition to this reasoning it is evident that the United States as a nation is becoming less and less dependent on the old world for such goods as the great mass of our people consume. The time has arrived, seemingly, when to a very great extent business men can be indifferent as to possible tariff changes. Many of them are disposed to accept as unavoidable certain reductions which both of the leading political parties favor and which it is thought can be adopted without injuring labor or disturbing mercantile and manufacturing interests.

There is a still more definite explanation of this complacency with which financial concerns regard the political situation. They firmly believe that the radical element is not going to work as much mischief in the future as it has in the past. The co-ordinate branches of the law-making bodies are acting as a check on each other, while the higher courts of the land are in a broad measure standing as a safeguard against unfair prosecution of corporate interests. There is a growing sentiment in this country that capital has its rights; that the nag-

ging of a legitimate business merely because it has dominating size and strength is unjust, and that the best interests of the public will be conserved by encouraging rather than hampering big industrial enterprises. There is a plain change of sentiment in this regard, so that demagogues and ultra-radical politicians are having less opportunity than formerly to cause mischief.

It has come to a time when thinking men who hope for constructive legislation are more afraid that Congress will not act at all than that it will act unwisely. Action is imperatively demanded by the business element for an improvement of the currency situation. The Monetary Commission's plan for establishing a national reserve association remains in status quo, while Congress pursues investigations which are poorly founded and very unpromising, to say the least. There has been ample time for definite action since the currency measure was introduced and the country at large would heartily sustain Congress in the passage of this or a similar bill designed to provide the nation with an adequate currency system.

Observing persons are impressed with the strength of sentiment in this direction. The monetary campaign has lasted much longer than a presidential contest lasts, and the educational effect has been far-reaching and beneficial. Business men of the interior, farmers, manufacturers, shippers, and small investors on the frontier and in new states are among the most earnest and intelligent advocates of an elastic currency. These classes have suffered long and patiently from monetary ills. They realize the great fundamental truths of the present financial propaganda, that there is not money enough in this country for crop moving and development work in times of prosperity and expansion, while there is too much in periods of dullness. An elastic currency is the crying demand of the age, so that there will be sufficient money in the busier months and not too much during the rest of the year. Bankers and all owners of capital carry a heavy and unjust burden when the financial market is dull and funds accumulate in an excessive way. On the other hand, merchants, shippers, builders, farmers and others are handicapped at times by a scarcity of cash even when they have ample security to offer for their loans.

A Central Reserve Association, according to the mature judgment of a majority of the American people, would afford proper facilities for correcting the defects which have been pointed out. If operated according to the plan brought forward by the Monetary Commission, this Reserve Association would be under federal control, would share its profits with the government and would at all times be in an absolutely safe condition because it would not issue currency except on securities of unquestionable character.

Money rates are now advancing, the gain amounting to one-half per cent or more since the first of this month. The improvement is due to a general broadening of trade and a large prospective demand in connection with crop moving. It is a welcome change for financial houses, for the fairly active commercial business all summer has not been sufficient to give full employment to bank funds. There still is considerable available capital for investment in the better grade of bonds and commercial paper. This class of buying has been kept up in large volume by the banks and their customers, although there is keen discrimination in the matter. Taking this branch of business in the aggregate it is affording an outlet for a great deal of capital, in eastern as well as western markets. The unusually free borrowing of money in London and Berlin, as well as in the Orient, continues a helpful factor in steady rates here. The Chicago market is also receiving the customary support from local real estate enterprises, which continue to use capital at fair rates.

The advance in real estate values in Chicago and throughout the West is notable. The rapid growth of the city accounts for this situation. Inside business property is paying well, and high-class residences almost equally so. A somewhat rapid advance in farm values is noted. This undoubtedly reflects an improved condition generally in the agricultural districts. All kinds of produce hold

(Concluded on page 348.)

EARTH FILL DAMS *

The ideal earth fill dam is an immovable mass overlaid with an impermeable face. If this ideal condition could be realized the entire mass would remain free from saturation, it would retain its effective dry weight, and its normal cohesion would be unimpaired. Unfortunately, the ideal condition cannot be even approximated. We must, therefore, search for a practical solution of the difficulty.

There are many high authorities on earth fill dams who contend that the embankment itself is the dam, and that to bisect it vertically by any form of core wall introduces a line of cleavage at the vital point of the dam, to its detriment rather than to its advantage. But there are two sides to this question as to all others.

Nor must we overlook the importance of an impenetrable barrier of some sort to prevent the boring of muskrats, crawfish, etc. All engineers seem to agree upon the value of this function of a core wall if there were no other.

The third stage. Therefore, we back it up on the upstream side as well by an earth fill, B, so that it may be stable during construction and whenever the pond is drawn down.

For convenience let us speak of B as the upper prism and A as the lower prism. We now see clearly that the functions of two prisms of the dam are wholly dissimilar.

The lower prism must have mass, must be maintained dry and must be free from settlement.

The upper prism—which is now only a subordinate part of the dam—need have mass only in proportion to its duty as a backing for the core wall, and may be wholly indifferent to saturation or permeability. In fact, there is no reason why the upper prism of the dam should not now be built of gravel, boulder or quarry stone without any attempt to secure impermeability—see Fig 2. This view of the case becomes entirely practical when the amount of earth available is only sufficient for the lower prism. Since we cannot prevent loss of weight by submergence anyway, whatever the material, the question of its porosity becomes indifferent.

Control of Saturation.

Of prime importance in an earth fill dam is the control of saturation within its mass. Lines of saturation are heretofore inevitable in earth fill dams, being caused by percolation of water from the reservoir and by subsaturation through the foundations.

Fig. 3 illustrates the ordinary saturation of an earth fill dam without a core wall. The only part of the dam of full efficiency as to weight is that shown in the light shading, and it will be noted that even this rests upon the unstable saturated mass below it. The line of saturation varies considerably according to material, but in some degree it is always present.

If a clay puddle wall is used as in Fig. 4, the situation is still not materially changed if there is a possibility of subsaturation through the base. This particular sketch is from an actual example in which the line of saturation in the lower prism was determined by test. Saturation, therefore, not only deprives the fill of its full effective weight, since all the material below the line of saturation is virtually submerged, but it introduces instability into the base of the dam itself. In other words, as to stability the ordinary earth fill dam is upside down.

Clay puddle wall or solid concrete core walls, etc., have been and still are used and unquestionably serve a certain useful purpose. But a clay puddle wall has no inherent stability, and is not impervious to boring animals or immune against shrinkage—and the concrete wall if massive is very costly, and if light is liable to destructive distortion.

The saturated material in the dam loses effective weight in proportion to its buoyancy. The degree varies with the

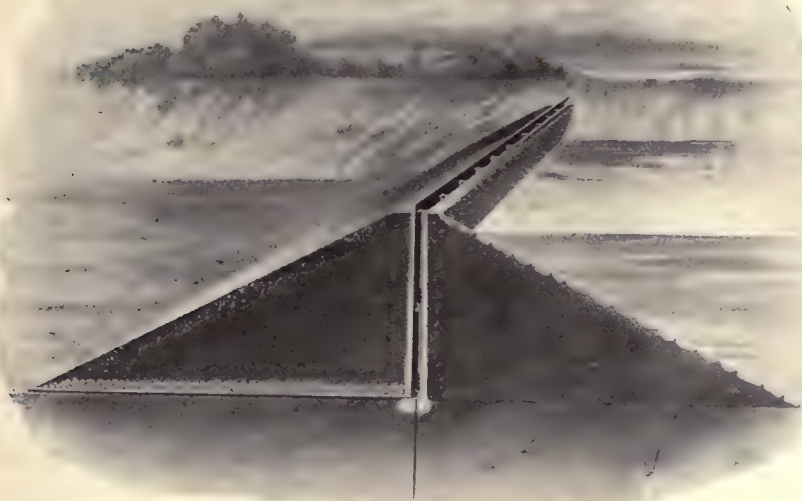


PLATE A.
Typical Section of Earth Fill Dam with Hollow Core Wall.

Now let us utterly divest our minds of all preconceived ideas and try a fresh line of reasoning.

The thesis is—the *core wall*, not the embankment, is the *dam*—therefore it must be (1) initially water tight, (2) not subject to accidental cracks, (3) indifferent to them if formed, and (4) permanent in position.

The conception of an earth fill dam, therefore, might pass through three stages.

The first stage. Referring to Fig. 1, if the core wall standing alone were the dam, it would comply only with the first and third conditions. That is, it is initially water-tight, and by making it hollow and providing exits for the water it is indifferent to chance cracks—but it is not stable.

The second stage. We will now support the dam by an earth embankment. A, below it, of sufficient mass and consistency to prevent any deflection or movement due to hydrostatic pressure from the pond. The fourth condition, namely—stability under pressure is now fulfilled and the second condition partially so. Unfortunately, with the pond empty the dam would be unstable from the thrust of the earth embankment, and the core wall would tip over backward.

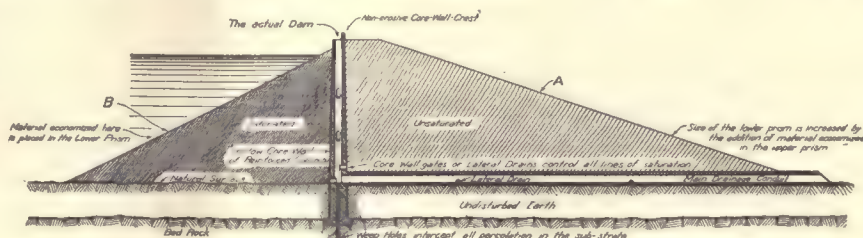


Fig. 1. Section of Earth Fill Dam with Hollow Core Wall.

nature of the material, but some loss always exists. Thus, if the material were open gravel, weighing when dry say 120 pounds per cubic foot, it would weigh when submerged only 84 pounds per cubic foot, owing to its displacement and allowing 40 per cent for voids—and similarly with other material.

Our thesis, therefore, makes it incumbent to interpose

*Courtesy Ambursen Hydraulic Construction Company, Boston, Mass.

a water barrier which will absolutely—we say *absolutely*—prevent any degree of saturation either from the pond or up through the foundations, thus maintaining the lower prism in its integrity of cohesion and effectiveness of weight. Such is the hollow core wall.

The Hollow Core Wall.

The hollow core wall is built of reinforced concrete, using a system of slip forms which admit of rapid and economical construction. Its preferred location is not in the center of the dam, but substantially at the upstream edge of the embankment: See Fig. 1. This throws more of the

Structurally, the hollow core wall consists of two com-

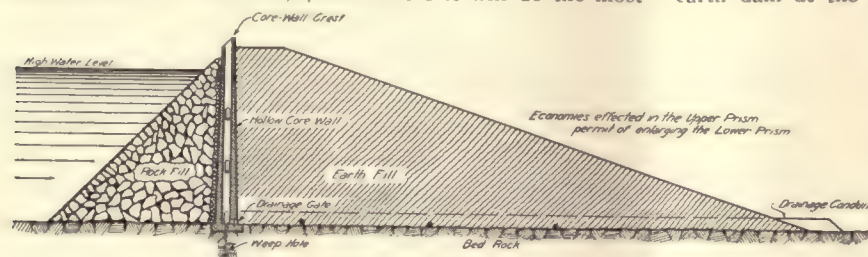


Fig. 2. Composite Dam with Hollow Core Wall.

good. Structurally, the hollow core wall consists of two comparatively thin parallel walls spaced by ribs which are monolithic with the whole structure and capable of withstanding the external collapsing pressure. The upstream wall is keyed into the impervious sub-structure, whether of rock, clay, hardpan, etc., thereby effectually intercepting the "creep" of water along the junction plane. The downstream wall need not be keyed in at all or at most but slightly. If deep-lying, water-bearing seams are suspected they may be reached and tapped off by a series of drill holes along the center line of the core wall.

Drains of large capacity are led from the core wall at frequent intervals out through the lower embankment, thereby discharging all collected water away from and below the dam. Small lateral drains under the lower prism may lead into the main drains, thus effectively removing all possibility of saturation from the under footing of the lower fill; see Fig. 5. As these drains are located wholly below the sealing core wall of the dam and afford a sure means of relieving any leakage accumulating in the core wall chamber, it is evident that they entirely avoid the otherwise objection of forming a "lead" for water to follow along their outer surfaces.

It is obvious, therefore, that any water which may find its way through the sub-material or through any joints in the core wall or from any source whatever is absolutely intercepted by the hollow wall and drained away. *For the first time, therefore, we have secured the essential of an absolutely dry earth prism for the downstream section of the dam.*

Moreover, the hollow core wall penetrates the heart of the whole mass. It may be made of any width between walls

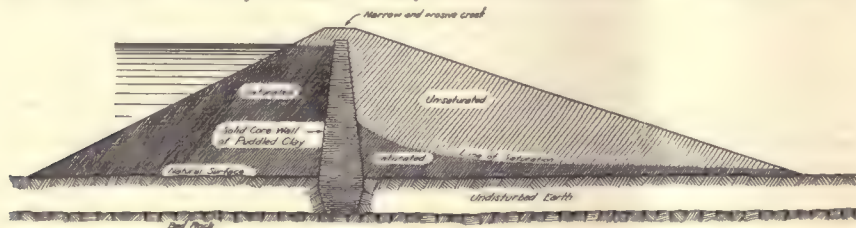


Fig. 4. Line of Saturation with Clay Puddle Wall.

without material increase of cost. Its trussed or cellular structure gives it great inherent stiffness. It is open to daylight from above and is accessible by permanent ladderways of iron rungs at frequent intervals. Openings through the partition walls at various levels give access to every foot of both surfaces. An unsuspected leak may, therefore, be

located and if possible closed—or if not closed we at least make certain that it is powerless for harm. In cost, the hollow core wall as a unit compares favorably with the cost of a solid core, but there are other features wherein the hollow core wall operates to reduce the cost of the dam as a whole below that of a dam with a solid core wall or even with a clay puddle. This will appear later.

Crest Protection.

All earth fill dams should have a crest of indestructible material to prevent wave wash or even the wash of spray which can collect into a runnel and ultimately enlarge into a wash out. Such a condition in its incipient stages is shown in Fig. 6 which is from a photograph of the little earth dam at the famous Horseshoe Bend on the Pennsylvania Railroad near Altoona. This dam is so located that it is subject to violent wind gusts coming down through a gorge in the mountains. A few years ago such a gust pushed the water to the lower end of the pond and actually blew it over the crest of the dam. The result was the beginning of a severe wash as shown in the view and had the pond been larger there is no doubt that the destruction of the dam would have followed.

Now in many locations the slope of the land is such that the dams are necessarily in the end of the valleys opposite the prevailing heavy winds. Hence, a wave run is set up which extends its full force on the dam and is a serious menace. Fig. 7 is a striking photograph of the Lower Latham Reservoir near Greeley, Colo., and will be referred to later.

We effectually meet this condition, as illustrated in Plate B, by carrying the downstream wall of the hollow core up above the level of the embankment, thus forming a parapet and effectually intercepting any wash either as spray or direct wave spill. It will even take care within limits, of an accidental surcharge on the dam due to extraordinary floods or carelessness in handling the waste gates. Such a device as the hollow core wall at Safety Crest would have saved many

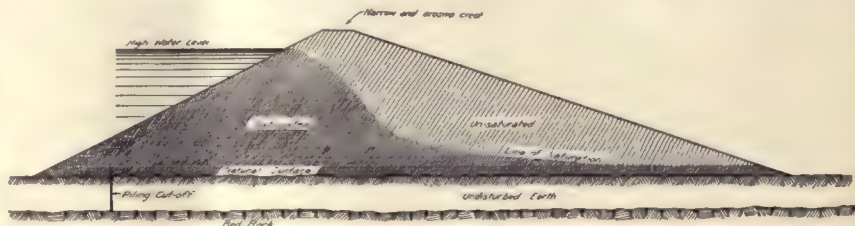


Fig. 3. Illustrating Line of Saturation; No Core Wall.

disasters which, like that at Johnstown, Pa., have gone down into history. Moreover, such a wall is embedded in the heart of the fill so that, unlike a pavement, water cannot work around and under it. The extension of a concrete facing vertically upward to form a parapet wall, while common practice, makes the stability of the parapet dependent on that of the facing, whereas when the parapet and core wall are monolithic no such weakness exists.

What such a protective device as the hollow core wall means is best illustrated without comment by object lessons. Figs. 8 to 13 inclusive are disasters to earth dams in the state of Colorado alone and in a period of only two years, namely, 1909 and 1910. Every one of these disasters would have been absolutely prevented with such a form of construction as we specify. Any engineer interested in the detail of these disasters can find same fully described in the fifteenth biennial report of the State Engineer of Colorado for these years. This portion of

the report covers some 30 pages, and to quote freely from the recommendation of the State Engineer as to how the dams should have been built or how they should be repaired would read almost like a specification of a hollow core wall dam.

Economy in Embankment.

We once more emphasize the fact that the hollow core wall as a whole is absolutely impervious. Its cellular construction and heavy reinforcement will defend it against cracks due to settlement or uneven pressure—but assuming cracks which would permit the passage of water, it is still impervious *as a whole*, since any water passing into the interior is carried away by the bottom drains. *The core wall itself is, therefore, effectively the dam*, and the earth embankment being merely adjuncts we can deal intelligently with each prism according to its functions.

In the first place we move the core wall, as stated, to the upper edge of the bank, thus getting more material in the lower prism, where being perfectly dry it is most effective.

The upper prism, on the contrary, has no function except to support the core wall in place when the pond is empty. It can, therefore, be materially reduced in section. To this end the top of the slope may be dropped from 6 to 10 feet below the top of the core wall, and the slope instead of being made 2 to 1 or $2\frac{1}{2}$ to 1 may be reduced to say $1\frac{1}{2}$ to 1, varying with the angle of repose of the saturated material. Fig. 14 indicates the large saving in earth which will result—an amount generally more than sufficient to offset the extra cost of the core wall. Fig. 5 shows the economy even more strikingly by contrasting the relative areas covered by the upper and lower prisms. (As these sketches are merely illustrative we omit all details such as berms, etc.)

Conduits and Gate Well.

In building an earth dam provision must be made for discharging the stream at various stages during construction. Our method of doing this is illustrated in Figs. 15 and 16. The first step is to construct one or more reinforced concrete outlet conduits, in size and number adequate to carry the flood flow of the stream and located in the lowest point of the stream bed. This conduit is reinforced longitudinally as well as in circumference so as to withstand both internal and external pressure, and prevent cracks by displacement. The conduit communicates with the hollow core wall, its continuity being broken at that point. During construction it is left open for discharging the stream; see Fig. 15.

When the dam is completed a service conduit of cast iron or steel is laid through the concrete tunnel and supported at proper intervals; see Fig. 16. It is sealed into the tunnel by a water-tight concrete block at the upper end, as shown in Fig. 17. In nearly all states an emergency gate is required in addition to the service gate. Where there is no large amount of sediment, the use of a gate tower can be avoided by arranging the secondary gate to operate along the slope of the embankment, thus avoiding the danger from ice pressure, which is always a menace to the detached gate house.

We are now at work designing a service gate and a practical means of operating the same from the crest of the dam without a separate gate house. We had hoped to include in this circular all these details. The accumulating demand, however, for the hollow core circular will not permit

If the gate house were built like a well in the body of the ordinary earth fill dam, that portion of the conduit upstream from the gate would always be under pressure due to the head in the pond. Hence, any settlement of the embankment would be liable to crack the conduit or open its joints. This would lead to over-saturation through the body of the fill, and would establish underground channels and ultimately create a washout as was the case in the Empire failure—Fig. 8. All the convenience of the interior gate well is, therefore, attained with complete avoidance of its dangers.

By the device here shown of a conduit within and independent of the tunnel, not only is the possibility of cracking reduced to a negligible quantity, but assuming a crack to

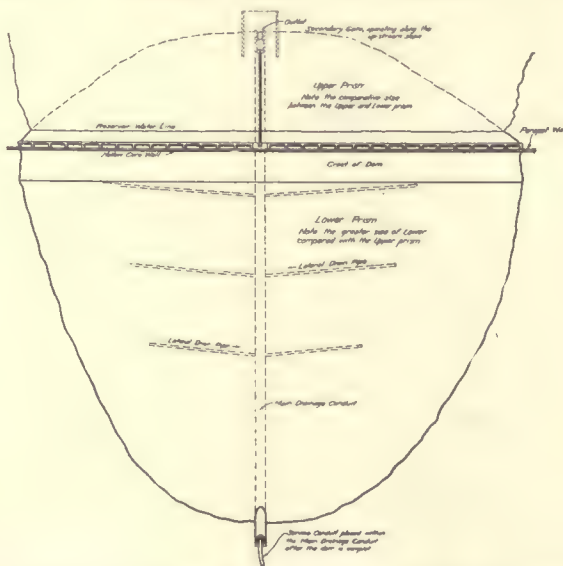


Fig. 5. Pplan View Illustrating a Single Trunk Drain with Laterals as Applied in a Short Dam. In Long Dams the Trunk Drains Are in a Multiple, Without Laterals.

occur, it could affect only the outer tunnel—or if we push the assumption still further and admit an open joint or crack in the service conduit itself, any discharge of water is nevertheless immediately drained away by the main tunnel assisted by the various drains running from the hollow core wall. The possibility of saturation from this source is, therefore, entirely eliminated and a material economy in cost secured.

Protection Against Ice.

In cold climates embankments are often injured by the thrust of ice either during formation or by the force of current or wind pressure. The usual rip-rap with which the face of the slope is paved is not calculated to afford the best protection. Its surfaces are too rough and the unit masses too small, hence, ice has a better chance to get a hold on it. We prefer to pave our slopes with concrete slabs in large masses adequately reinforced, having smooth surfaces and more or less joined together. Saturation from the pond is thereby reduced to a minimum and danger from ice practically eliminated.

At the moment of writing we have under advisement an improvement in the paving of earth slopes, which, if satisfactorily worked out, will appear in our advertisements and in a future edition of this circular.

Wind Protection.
We have already shown in Fig. 6 one instance of incipient destruction even on a very small reservoir. Fig. 7 is a photograph of the Lower Latham dam in Colorado near Greeley. A severe wind storm in April, 1912,

acting on a reservoir surface of considerable extent set up a wave action which very nearly swept away the entire crest of the dam. Heroic work on the part of the community enabled them to save the dam from actual disaster by the use of sand bags.

Plate B illustrates the protection afforded by the hollow wall and pavement.

(Concluded in August issue.)



Fig. 6. Altoona Dam, Showing Incipient Failure From Wave Spill.

us longer to delay its publication, and, on the other hand, we prefer to show no details except such as are thoroughly worked out. In Fig. 17, therefore, we have only conventionally indicated an emergency or secondary gate.

The main service gate is in the bottom of the hollow core wall which therefore supersedes the usual costly gate house, and leaves this item as a further credit to offset the cost of the core wall.

NITRIFICATION OF THE SOIL

The process of oxidizing ammonia to nitric acid is termed nitrification. Scientists are bending much of their energy toward soil improvement along this line. One step necessary in the direction of larger crops is a study and understanding of the soil.

If the summer working of fallow land helps to retain water in the surface soil, this water may have a powerful influence upon the production of nitrates for the next crop.

A growing crop may reduce the nitrate supply for the next crop in two ways—it may use up all the nitrates actually present, and it may so dry the land that nitrification in the interval between crops is reduced to a minimum.

The moisture requirements for nitrification suggest that in dry seasons a single flooding of fallow land might be followed by good results.

Nitric acid or nitrate contains nitrogen in the highest state of oxidation. Ammonia is a compound of nitrogen which has no oxygen. To convert ammonia into nitric

to make the soil compact. A mark was placed on the bottle at the soil level, the soil was replaced by water to the same mark, and from the weight of water required the apparent S. G. of the soil was determined. From this and the real S. G. as found by the displacement method, the porosity of the soil, and from this the total water-holding capacity was found by calculation. There were two sets of experiments in consecutive periods, using about 100 bottles each. In the first experiments water was added to bring the original soil moisture up to 10, 20, 30, 40, 50, 60, and 70 per cent of its total water-holding capacity in different bottles. In the second, the steps were 10, 20, 30, 50, 70, and 90. All the bottles were marked to the same volume, and the same weight of dry soil was used in every case.

Before charging the bottles, the weighed soil was thoroughly mixed with its proper quantity of water in a Wedgewood mortar. One-half of the bottles got water only, the other half got 5 c. c. standard ammonium sulphate solution in their water. After filling, the bottles were placed in a dark cupboard in the laboratory, and the temperature of the cupboard was read daily at 9 a. m. and 5 p. m. The bottles in the cupboard were corked. Twice weekly each bottle was taken out, uncorked, aspirated for 5 seconds with the suction pump, corked and replaced in the locker.

The method of using closed bottles and aspirating seemed better than the method of using open bottles and adding water lost. In order to judge of the two methods, six bottles were left open, and the results compared with closed aspirated bottles after a period of twenty-eight days.

With closed bottles the losses were insignificant, while with open bottles usually more than one-half of the original moisture was lost. The lost water in open bottles cannot be replaced in a satisfactory manner, because at the point where the water is added the soil will be much wetter than at other points in the soil mass. To demonstrate this, a glass tube of 1-inch bore was packed with soil to the same degree as in the experiment bottles, and to a depth of 10 inches. Water was then added from the top equal to 10.70 parts per 100 dry soil (40 per cent of its water-holding capacity). At the end of seventeen days the tube was cut into four sections of 2½ inches and the moisture in each determined. Of the total water in the soil there was found in the top section 35; in the second, 31; the third, 24; and in the fourth, 10 per cent. With a smaller quantity of

water, or with a shorter time allowed, the differences would probably have been greater than here noted.

In each experiment the ammonia bottles and the control blanks were done in duplicate, and the average results are taken where the figures are close, when wider, the average is marked doubtful. This happens in two instances with the very wet soils of the second experiments.

In the chemical analysis the larger percentage of lime, and particularly of carbonic acid, in the clay is notable as representing available base. The sandy soil with .032 carbonic acid falls below the minimum requirements, and is apparently deficient in available lime.

Between 40 and 70 per cent of the water-holding capacity, rate of nitrification, did not vary in any important degree. At the various steps below 40, there was a notable falling away; 10 per cent practically stopped nitrification, and at 20 the rate was only one-seventh of the best case. Another duplicate set of bottles set up at the same time, but analyzed one week earlier, showed results on a lower plane for each degree of moistness, but placed them in the same order of merit.

Nitrification is inactive in these soils while they still contain about three times more moisture than in their average air-dry condition.



Fig. 7. Lower Latham Reservoir, Greeley, Colo. Destruction by Wave Action, April, 1912.

acid, its nitrogen must be oxidized. This happens in fertile soil, and the oxidation is brought about by certain bacteria.

Besides nitrogen and oxygen plants require eight other elements in their food materials. Each of these must be in the highest state of oxidation commonly occurring in Nature. Phosphites, sulphites, nitrites, and ferrous salts either kill the plant outright, or they give an unsatisfactory return. This is also true of ammonia for ordinary crop plants. Ammonia is not poisonous in practical amounts, but it gives a much smaller yield than the highly oxidized nitrogen found in nitrates.

If moisture is necessary for nitrification, it follows that conservation of soil moisture has a double purpose. The moisture is held in reserve for the use of a future crop, but its presence meanwhile tends to the production of nitrates. To find how far exactly, and within what limits the presence of soil moisture has an effect upon the production of nitrates was the object of recent experiments.

The method of investigation was as follows:—Air-dry soil equal to 300 grams dry soil was placed in a bottle of 3 inches diameter, 6 inches high, neck 1½ inches, and of 500 c. c. capacity. Sufficient tapping was given

Supreme Court Decisions

Irrigation Cases

TITLE.

In an action for damages to crops by destruction of a flume feeding and conveying water to irrigate plaintiff's land, proof of plaintiff's occupancy for over 30 years is sufficient proof of title without deraigning a record title. *Gustin v. Harting*. Supreme Court of Wyoming. 121 Pacific 522.

RIGHT TO USE WATER.

The right to the use of water under a grant from the owner is an incorporeal hereditament, and, as a contract with respect to it cannot technically establish the relation of landlord and tenant, the most appropriate remedy to protect such an interest is a suit in equity. *Custer Consol. Mines Co. v. City of Helena*. Supreme Court of Montana. 122 Pacific 567.

PRIORITY.

Under the provisions of section 5, art. 15, of the Constitution, whenever more than one person has settled upon or improved land with the view of receiving water for agricultural purposes under a sale, rental, or distribution thereof, as among such persons priority in time gives superiority of right. *Mellen v. Great Western Beet Sugar Co.* Supreme Court of Idaho. 122 Pacific 30.

AMOUNT APPROPRIATED.

A water appropriator's right will not be limited by the capacity of his canal while out of repair, unless that condition has existed for such a long time as to indicate his intention to claim no more water than the canal in that condition will carry. *Bailey v. Tintinger*. Supreme Court of Montana. 122 Pacific 575.

FAILURE TO SUPPLY WATER.

Under the provisions of the settler's contract, it is provided that interest from April 1, 1909, at 6 per cent per annum may be charged on balance of purchase price if water is available from the canals of the company for use during the irrigation season of 1909, and, if not available for that season, that interest shall commence when water is available. *Hanes v. Idaho Irr. Co., Limited*. Supreme Court of Idaho. 122 Pacific 859.

POINT OF DIVERSION.

In a proceeding to obtain permission to enlarge irrigating canals of another person under Comp. Laws 1907, § 1288x 22, it is no objection to the maintenance of the proceeding that plaintiff's right is a right to divert water at a point above the point of diversion of defendants' canals, where it appears that plaintiff can divert his water at the point where the canals divert water. *Tanner v. Provo Bench Canal and Irrigation Co.* Supreme Court of Utah. 121 Pacific 584.

APPROPRIATION.

The mere possession by one person of a water right by another does not show such privity as will enable the former to claim his right as of the date of original appropriation, but to do so the possessor must show some contractual relation between himself and the original appropriator or privity with him under the laws of succession, otherwise the initiation of the right of the possessor must be fixed as of the date of the taking possession and subject to water rights acquired by others. *Kenck v. Deegan*. Supreme Court of Montana. 122 Pacific 746.

RATIFICATION OF CONTRACT.

Where a purchaser of substantially all of the stock of a corporation organized to supply water for irrigation contracted with the seller to furnish water from the ditches of the corporation for the irrigation of described parcels of land of the seller, and, after the purchaser became the managing officer of the corporation, payments were made to it for furnishing water on the lands described, the contract was ratified by the corporation, and it was bound by it. *Ulrich v. Pateros Water Ditch Co.* Supreme Court of Washington. 121 Pacific 818.

RIPARIAN RIGHTS.

Each riparian owner is entitled to a reasonable use of water as an incident to his ownership, and as all owners on the same stream have the same right the use of each must be consistent with and qualified by the rights of others; but a lower riparian proprietor may not go upon or above the land of an upper proprietor and take water which is wont to flow

upon such land, and is necessary for the reasonable use of such upper proprietor, without returning it, since such appropriation by the lower proprietor is unreasonable. *Miller v. Baker*. Supreme Court of Washington. 122 Pacific 604.

NECESSITY OF DIVERSION.

An act of 1870 (Laws 1869-70, p. 57) limited the right to appropriate water for irrigation purposes to persons or corporations having the title to or possession of agricultural lands. The provision was omitted from the Codes of 1895 and 1907, and under the decisions an appropriator need not be an owner or in possession of land in order to make a valid appropriation for irrigation purposes. Const. art. 3, § 15, provides that the use of all water now appropriated or that may hereafter be appropriated for sale, rental, distribution, or other beneficial purpose, shall be held to be a public use. Rev. Codes, §§ 3803, 3819, authorize the formation of a corporation to supply water to the public. Section 4841 declares that the use of water taken must be for a beneficial purpose, but that such use need not be immediate, but may be prospective. *Held*, the requirement of actual use to complete an appropriation would defeat the purpose of the Legislature and public policy of the state to encourage public service companies for irrigation enterprises, as in many instances the complete use of the land taken would be impossible, owing to the unsettled condition of land irrigated, and an appropriation according to the statutory requirements is complete without the actual diversion of the water. *Bailey v. Tintinger*. Supreme Court of Montana. 122 Pacific 575.

CONTRACT TO SUPPLY WATER FOR IRRIGATION.

An irrigation corporation contracted to supply water to a customer on a form partially printed and furnished by it. The printed provisions bound the corporation to furnish to the customer all the water that might be required for irrigation, and bound the customer to construct a ditch from a gate placed in the bank of a canal. The written provisions described the land to be irrigated, reserved to the customer the right to relocate water at any time prior to the use of water, and declared that the first payment should commence when water was ready "for delivery at the highest possible level on the north line" of the N. W. $\frac{1}{4}$ described. The corporation had previously contracted to deliver water in a branch running on the north line of the customer's land to a point most convenient for delivery of water for use on the land; but physical conditions interfered with performance thereof. The corporation, on entering into the present contract, represented to the customer that it would deliver the water at the highest point on the north line of the quarter section, and for some time the customer received the water at such point. *Held*, that the contract obligated the corporation to supply water at such point, when construed as required by Civ. Code, §§ 1638, 1639, 1641, 1647, 1649, 1651, and Code Civ. Proc. § 1860, requiring the court to ascertain the intention of the parties, and, where a contract is partly written and partly printed, the written part controls, etc. *Bonslett v. Butte County Canal Co.* District Court of Appeal, Third District, California. 122 Pacific 821.

CENTER, SAGUACHE COUNTY, COLORADO.

Situated in the midst of a splendid irrigation system and in the most fully developed section of the San Luis Valley, the town of Center is one of the fastest growing towns of southern Colorado.

Center is an inland town, located 14 miles from a railroad; and about midway between Hooper and Monte Vista, the shipping points.

The irrigation system of Center is equal to any in the valley and there are under construction two large storage reservoirs which will store enough when completed to furnish 160,000 acre feet. The principal crops of the farms around Center are cattle, sheep, hogs, horses, poultry, grain, alfalfa, peas, potatoes, sugar beets and vegetables of all kinds. The wheat crop in 1911 averaged 35 bushels to the acre. Field peas are raised very extensively and fed on the ground to lambs and hogs. There is a plentiful supply of artesian water around Center and this is another big help in fattening stock.

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Reclamation Notes

CALIFORNIA.

The Union Colonization Company, of Merced, owned by the United States Farm Land Company, which is interested in large tracts of land in various parts of the country, has purchased the Chowchilla ranch, the consideration being over \$2,000,000. The ranch contains 108,000 acres and is located on both sides of the Chowchilla river at and above its junction with the San Joaquin river. The tract will be subdivided and placed upon the market in tracts to suit purchasers. A townsite to be known as Chowchilla is now being platted. Water for irrigation will be secured from pumping plants.

The Natomas Consolidated, of Sacramento, are installing pumps at Alder creek on the American river, from which point water will be taken for the main irrigating canals of the 30,000-acre tract which is to be sold in small tracts. Most of the land lies close to Sacramento.

The Santa Ana Valley Irrigation Company has completed its new well on the 20-acre property purchased some time ago near Olive. The well is producing 250 inches of water under the pump and is considered very satisfactory.

A. P. May, E. R. Walker, H. C. Kerr and H. R. Crozier, all of Coalinga, are financing a large irrigation project in Sacramento county. The tract consists of 20,000 acres. A storage reservoir and ditch system will be constructed to take water from the Consummes river for irrigating purposes. The capacity of the storage system will be 40,000 acre feet, and sufficient water can be stored to cover the entire 20,000 acres in the driest years.

On June 21st the Utah Construction Company finished the 7,000-foot tunnel on the irrigation system of the Oakdale irrigation district. The bore was finished in record-breaking time, less than 110 days having elapsed from the time actual work on the bore was commenced. The main ditch of the Oakdale district from the headgates to the edge of the district is completed with the exception of 1,380 feet of tunnel, and this is being finished at the rate of 30 feet a day.

Col. Carl J. Young, of San Francisco, is at the head of a big irrigation project to be constructed in Honey Lake district near Amadee, Lassen county.

The Richgrove Water Company has filed articles of incorporation. Principal place of business is Richgrove, Tulare county; capital stock, \$25,000. G. A. Hart, F. C. Ensign, W. A. Francis, F. H. Dice and G. H. Barnes, all of Los Angeles, are the incorporators.

Contractors in charge of the construction of the South San Joaquin irrigation district reservoir are making preparations for the early completion of the work so as to be in readiness to retain the flood waters during the winter months, thereby making it possible to irrigate thousands of acres in the summer season. It is thought that early in September the reservoir will be in shape to receive the water, and next year the entire southern part of the country will be assured of plenty of water for irrigation purposes.

COLORADO.

An election was held at Nunn on June 18th to vote upon a \$2,400,000 bond issue which will cover land included in the northern Colorado irrigation district, in which many Denver men are interested. The land lies in northern Weld county and embraces some 50,000 acres.

Farson Son & Co., of Chicago have announced that their company has made arrangements to pay the deferred interest on the 6 per cent bonds of the Greeley-Poudre irrigation district of Colorado.

For \$5,000 the Cripple Creek Deed, Drainage and Tunnel Company has sold to the Marygold Irrigation and Power Company, of Cripple Creek and Canon City, all the water

from the portal of the Roosevelt tunnel which is unwatering the Cripple Creek district. Tully Scott and associates of Cripple Creek are interested in the Marygold Company. Water will be diverted from Cripple Creek into the Marygold canal for the irrigation of about 5,000 acres of land in Fremont county. The flow is at present about 12,000 gallons a minute, and the prospects are that this volume will continue for several months. The tunnel company has reserved all power rights on the water flow and in winter time the irrigation company will impound a very large reservoir above Canon City for use in the summer months.

Sam Farmer, of Denver, has financed the Escalante irrigation project, the land under which is from 17 to 18 miles from Delta. The sum required to build the project is \$275,000, and it has already been subscribed by eastern capitalists. Mr. Farmer has already expended \$40,000 on the project, and work on 25 miles of ditches and six reservoirs will be resumed at once. There are 14,000 acres of irrigable land to be brought under the ditch. One and one-half feet of water is guaranteed by the promoters for every acre of land under the project.

After negotiating for more than two years, it is reported that the Greeley-Poudre irrigation system, which will involve an expenditure of \$5,100,000, has been financed. C. F. Tew, of Greeley, is interested in the project, which embraces 125,000 acres.

The Denver Chamber of Commerce recently adopted a strong resolution insisting that the Department of the Interior grant a right-of-way to the Henrylyn irrigation system for the tunnel by which it expects to bring water from across the range to reclaim 100,000 acres of land near Denver.

Work on the Fort Lyons irrigation system near La Junta is rapidly nearing completion. The heavy work on the canal is practically finished and all that now remains is to widen the channel already dug. The canal connects the Arkansas river and Horse creek with the reservoirs, which are located, one 12 miles northeast of La Junta and the other on Adobe creek, 20 miles northeast of this place.

OREGON.

In an effort to obtain additional funds with which to develop the East Side Irrigation Company's plant near Hood river, it was discovered that the contracts of the company with the water users are at variance with the charter of the company. At a recent meeting of the stockholders of the company steps were taken that will probably lead to the organization of an irrigation district under the state laws. The East Side Irrigation Company is a co-operative concern and owns one of the largest irrigating plants in the Hood river valley, watering the east side apple district. The main canal of the company's system is nearly 18 miles long and comes through a mountainous country.

The Vale-Oregon Irrigation Company, whose principal office is at Vale, has filed on 300 second feet of water to be stored in two reservoirs in Bully creek. This project will reclaim about 24,000 acres of land northwest of Vale in Malheur county.

The work on the irrigation project in the upper portion of the Klamath country will likely not be begun this year. The project is proposed under the state act. Preliminary surveys have been made and it is estimated that the Horsefly reservoir will furnish water for approximately 30,000 acres. It is now proposed to have a consulting engineer go over the project and if he confirms the reports of the local surveyors the plans will be submitted to the state engineer, but before his approval can be secured the season will be so far advanced that no construction work can be done this year. The promoters of the project plan to get everything in shape so that during the year of 1913 the main portion of the work can be completed.

TEXAS.

McCutcheon & Sons, of Denver, Colo., have purchased the G. W. Hutchinson ranch north of Pyote. The deal involved twenty-two sections of land and about 400 head of cattle. The consideration is stated to have been over \$100,000. The land lies in the shallow water belt and the McCutcheon

interests contemplate developing the land by pump irrigation and colonizing it.

Pearsall Land and Irrigation Company, with principal offices in San Antonio, have filed a charter with a fully paid-up capital stock of \$100,000. The incorporators and directors are: W. S. Haynes, G. B. Gouger, George M. Clifton of San Antonio, J. H. Bain of Stockdale, and W. W. McCrory of Edna.

A movement is on foot to construct a dam across the San Diego creek near Alice, which will irrigate between 50,000 and 60,000 acres of land. The work under consideration consists of an immense dam 17,000 feet long and reaching a height of 63 feet. The cost of the project is estimated at \$1,000,000, and actual work is expected to start this fall. The project is to be pushed through by the San Diego Irrigation Company, an association of landowners, who will be benefited by the undertaking. The main office of the company is at San Diego, Tex.

The water right owners under the Barstow irrigation system have organized in co-operation with the company and adjacent landowners and are formulating plans toward the construction of a reservoir to conserve the flood waters of the Pecos river to augment the normal flow during the irrigating season, as well as to place a large area under irrigation. The reservoir site has been located and some work already started, and as soon as matters can be shaped, bonds issued, or money raised, the work will begin and be rushed to rapid completion.

The Denton Colony Company, of Carrizo Springs, will construct dams across the Nueces river and install pumping plants and lay out a system of canals and ditches for the purpose of irrigating 68,000 acres of land in Dimmit county.

UTAH.

Judge Joshua Greenwood and J. L. Louder, of Parowan, and D. D. Houtz and W. L. Cook, of Salt Lake City, are interested in a new irrigation project that will water several

thousand acres of land. The project is to be known as the Rush Valley Reclamation project. The land is located in Rush Valley in Iron county. The project involves the drainage of Little Salt Lake, building of a dam at the mouth of Hydroglific canyon to form a reservoir for storing water now exhausted by evaporation each year, and the cutting of a canal.

The Midwest Engineering Company, of Omaha, Neb., has been awarded the contract at \$16,380.39 for the construction of drop, chute and bridge abutments on the Indian creek and Trail Hollow diversion canals of the Strawberry Irrigation project.

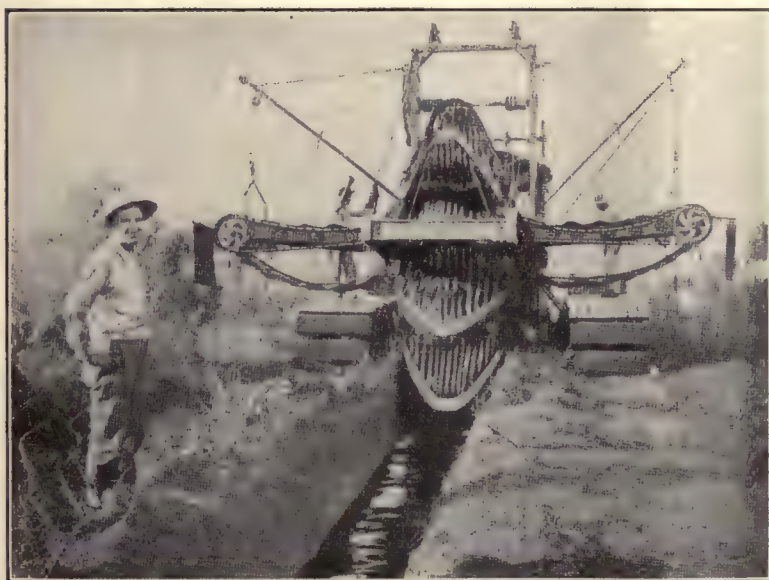
Strawberry tunnel, a four-mile bore through the Wasatch mountains, was holed through on June 20th. This is one of the most spectacular and important engineering feats of the Reclamation Service, its purpose being to convey water from Strawberry river in the Colorado drainage basin into the great American desert, which has no outlet to the sea, where it will be used in the reclamation of about 60,000 acres of land in the vicinity of Utah Lake. The approximate cost of digging this tunnel is \$1,000,000.

Caleb Tanner, the state engineer, has indorsed the project of the Neponset Land and Livestock Company, which proposes to irrigate 5,000 acres of land in the northeastern part of Rich county, provided a government right to reclaim the land can be secured.

The Pahvant Irrigation Company, of Salt Lake City, has filed articles of incorporation; capital stock, \$16,000, divided into shares of \$1.00 each. Water for irrigation purposes will be taken from Sevier river to irrigate 16,000 acres of land.

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Section 2. The American Reclamation Federation is organized for the promotion and encouragement of the irrigation, reclamation, drainage, colonization and development of land within the United States of America, and to facilitate conference and deliberation among the people of the country concerning such reclamation and related interests, especially to promote agreement and concerted action among those organizations interested in the conservation and proper utilization of our natural resources to the end that united efforts may be towards agreed upon ultimate results.

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Organizations and individuals interested in reclamation are invited to become members. Detailed information concerning initiation fees and dues will be furnished upon application to the secretary. Address

D. H. Anderson, Secretary
30 North Dearborn St.,
Chicago, Ill.

THE SAN JUAN BASIN.

The San Juan Country, comprising that section of Colorado which includes the counties of San Miguel, Dolores, Montezuma, San Juan and La Plata, has attracted not only a vast army of followers of the "back to the farm" movement but also many mining investors eager to participate in its mineral wealth.

Extending from Telluride on the northwest to Allison on the southeast the San Juan basin contains the two important cities of Telluride and Durango, the former the most important mining center of southwestern Colorado, the latter both an agricultural and mining metropolis.

Telluride.

The city of Telluride, with its 3,000 inhabitants, is the county seat of San Miguel County and the center of a rich mineralized section embracing more than 200 square miles of territory which has in the past 15 years yielded more than \$1,000,000 in value annually. It is situated in a picturesque valley and is reached from the north by way of Denver and Grand Junction on the main line of the Denver and Rio Grande Railroad. It is also the western terminal of the Rio Grande Southern, which road by connecting Telluride with Durango serves the mining town of Rico as well as the agricultural communities of which Dolores, Mancos and Cortez are the shipping points.

Durango.

Nature has truly blessed the San Juan Basin. Its soil is unsurpassed in fertility and productivity; its many streams amply supply its many irrigation systems with water; its lands are easily irrigated and its climate is ideal.

And yet the development of this section has scarcely begun; several irrigation projects are under way which will develop thousands of acres of fertile land and furnish homes to tens of thousands of farmers and homeseekers to whom Durango will of necessity be a market place.

La Plata County, of which Durango is the county seat, is the most highly developed (agriculturally) section of the San Juan District. Durango is comparatively a young city. It was founded in 1880 and its growth has been the result of natural conditions. Mining and agriculture have been its mainstays and these industries have combined in developing it into a beautiful city of 10,000 inhabitants, and having all the essential requirements of a modern city. It has broad, regular, paved streets; schools; banks; churches and manufacturing plants which have been important factors in its commercial development. Among the latter the most important are the smelter of The American Smelting and Refining Company; the machine shops of the Ball Foundry and Machine Company and the foundry of the Vulcan Foundry Company; the two latter employing a number of men in the manufacture of mining and irrigation machinery.

Among other enterprising towns of La Plata County may be mentioned Ignacio, Bayfield, Oxford, Tiffany and Allison. Ignacio and Bayfield are located in the Pine River Valley, and are important trading points on the Denver and Rio Grande Railroad between Durango and Alamosa. The lands tributary to Ignacio were formerly part of the Southern Ute Indian Reservation. The Federal government from time to time diminished the reservation and threw the lands open to settlement. The townsite of Ignacio is located on the west bank of the Pine River and is at the present time the scene of considerable building activity, and what a few years ago was a vast expanse of sage brush is now a fertile valley thickly dotted with farm houses, modern residences and scores of substantial business buildings. North of the townsite are located the government buildings, Indian school and Indian trading store of Hans Aspaas the licensed trader.

The oldest town in the Pine River Valley is Bayfield and while an inland town it is a flourishing community surrounded by fertile irrigated lands.

The towns of Oxford, La Boca, Tiffany and Allison are at the present time but small settlements of from 20 to 30 families, but with an assured future. In the Oxford district Mr. F. Brockenauer, the postmaster, has made a marked success in the raising of fancy poultry, and the Oxford Townsite Company is, under the management of Mr. L. A. O'Donnell, developing extensive fruit tracts.

In a future article the writer will treat of the commercial and irrigation development of La Plata County.

ALAMOSA, COLORADO.

An impression of immensity compels the mind as one enters the San Luis Valley and that impression remains with greater force the more one travels through the valley.

As you enter, whether from the east over La Veta Pass or from the south over Cumbres Pass, the eye is met by a vast stretch of land seemingly as level as the proverbial table with the line of the horizon formed by lofty and snow-clad mountain peaks among which the mighty Blanca towers as a giant monarch.

Geographically the San Luis Valley is located in the south central part of Colorado, extends over an area as large as that of the state of Connecticut and includes four counties within its boundaries, viz., Costilla, Conejes, Rio Grande and Saguache, which combined cover about 3,000,000 acres of as rich irrigated and irrigable land as can be found in any part of the West.

The San Luis Valley enjoys a climate peculiarly its own. Protected and sheltered as it is by mountain ranges on all sides winter storms are rare, blizzards are unknown and the fall of snow in the valley so light that the live stock graze in the open the year around without injury or discomfort.

The town of Alamosa, a thriving community of about 4,000 and the population of which has more than doubled in the past 4 years, is rightfully designated as the "Hub of the San Luis Valley."

Located almost in the center of the valley, it is the hub from which the railroads radiate to various parts of this agricultural empire.

The Denver and Rio Grande Railroad, that most effective factor in the development of Colorado, through the sagacity and foresight of its officials, early discovered the latent possibilities of the valley. Its emissaries saw that the pioneer Mexican settlers, with none or very crude methods of irrigation, were harvesting profitable crops as a result of desultory farming and the railroad officials were quick to realize that the only requisite to the proper development of the San Luis Valley was transportation facilities.

The fourth division (one of the largest of the system) of the Denver and Rio Grande Railroad was established at Alamosa. For several years Alamosa was the terminus of the road, but with the development of southern Colorado and northern New Mexico, the line was extended southward to Antonito, Santa Fe and Durango; a branch was built running westward to Creede and serving Monte Vista and Del Norte while the Salida branch, a mighty factor in the development of Mosca, Hooper, Moffat, Villa Grove as well as the inland towns of Center and Saguache, placed Alamosa and the San Luis Valley on the railroad map from the Pacific Coast and Salt Lake City.

Over 600 men are employed in the Alamosa machine and car shops of the Denver and Rio Grande Railroad; the pay roll of these plans aggregate from \$500,000 to \$600,000 a year.

During the past year considerable interest has been aroused in a proposed electric road which is intended to connect the towns of Del Norte, Center, Saguache and Villa Grove; and while the matter is in the embryo state there is no doubt that the San Luis Valley offers an excellent field to trolley road builders. The many prosperous inland towns of the valley would undoubtedly welcome all propositions of that nature and support them both morally and financially.

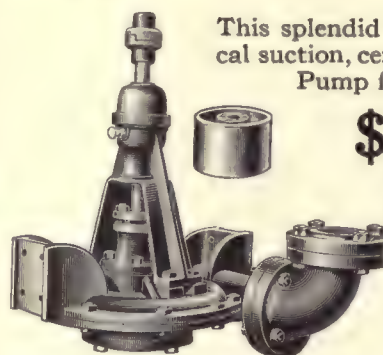
The influx of new-comers from the East has more than doubled the population of Alamosa in the past three years. The old residents have built a modern, delightful, home-like city, attractive from a social as well as business viewpoint.

Alamosa has three school buildings, a high school, 15 teachers and an enrollment of 650 pupils; five church buildings in which seven religious denominations are represented, a \$6,000 Carnegie library, theaters, opera houses and electric light plant and a modern fire department.

Among its business men Alamosa numbers many progressive, wide-awake and enthusiastic merchants, who have kept abreast with the progress of the community.

An active commercial club of which merchants, professional men and farmers are live members, is ever on the lookout for the establishment of new industries and to interest capital in meritorious enterprises.

A real estate exchange, composed of the leading land and real estate dealers of the town, makes it its special



This splendid 70 gallon vertical suction, centrifugal Buffalo Pump for only

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duty to protect prospective land buyers and home-seekers from unscrupulous land sharks.

Through its commercial club and real estate exchange Alamosa invites and will co-operate with outside capital to establish two needed industries in the community, namely, a pea canning factory and a packing plant with sufficient capacity to handle hogs and sheep in large quantities.

There exists also in Alamosa a propitious opening for a wholesale grocery and jobbing house. With its unequalled railroad facilities and its location it is the natural distributing point of the valley; and is destined to become a wholesale center of great importance. At the present time the retail merchant of the San Luis Valley is dependent on Pueblo and Denver for his groceries and other merchandise.

Deposits in the two banks of Alamosa aggregate over \$800,000; Roper's Insurance Agency, which has been established for over 25 years, represents 30 of the world's leading insurance companies and is the largest agency in Colorado; the firm of Galbreath Brothers, operating a saw mill, find a steady and gratifying demand for lumber and building material for the many new buildings in the course of construction, over 100 residences having been erected in the year 1911; in city and suburban real estate trading is, and has been, very active during the past three years and Mr. John Gerteisen, the town clerk and manager of The Gerteisen Company, reports that the values are increasing substantially. The Alamosa Steam Laundry is constantly increasing its force of employes and its field of operations is gradually extending to every section of the valley.

Alamosa has excellent hotel accommodations; it supports four progressive newspapers and the post office receipts exceed \$10,000 a year assuring free mail delivery.

There are several main canals furnishing water for lands around Alamosa, the principal ones being the Commonwealth, Costilla, Excelsior, San Luis and Hickory Jackson. The yearly assessment is from \$10 to \$15 for 160 acres. The supply of water from the Rio Grand River, which flows through the town, is ample to irrigate every acre of land.

Alamosa has 140 strong flowing wells, from which the entire water supply of hundreds of houses is taken. It is possible for every house owner to have his own water works at home. By drilling a well an inexhaustible supply of the purest artesian water is obtained by its own pressure.

All crops subject to cultivation at an altitude of 7,500 feet are successfully raised in the Alamosa district. Many prizes have been awarded to the products of the San Luis Valley at various fairs and land shows. Wheat, oats, sugar beets, flax, cabbage, barley, potatoes, onions and alfalfa have been among the prize winners for the valley products and the San Luis Valley is acknowledged to be the chief pea feeding section of Colorado. This industry averages a profit of from \$35 to \$50 an acre.

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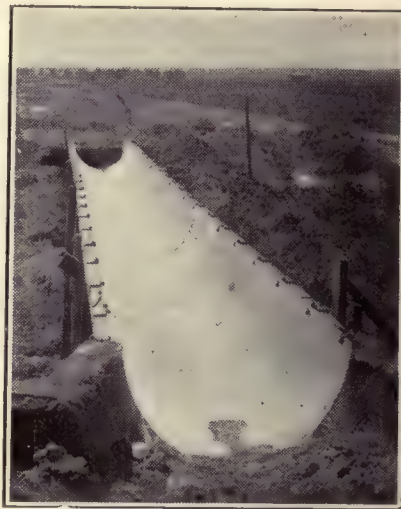
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MISCELLANEOUS RECLAMATION NOTES.

The Beverly Land Company, of Beverly, Wash., has completed the installation of the irrigating system near that city. Twelve miles of pipe conduct water to every part of the tract and there is a hydrant on the high point of each 10-acre piece. A reservoir on the hill holds 1,000,000 gallons. This will be kept full at all times to maintain the pressure on the pipe system.

O. S. Brown, of Prosser, Wash., was the successful bidder for the construction of the irrigation system to be installed in that city. His bid was \$31,795. The system will supply every lot in the city with irrigation water, the city having purchased a water right from the government.

The city of Pasco, Wash., has purchased a 500-acre water right from the Pasco Reclamation Company for the purpose of irrigating city property. The reclamation company agrees in the contract made with the city to furnish 24 inches of water. At the end of five years a co-operative water users association is to be formed.

Hon. Thomas Lyons, of Silver City, N. M., is improving an irrigation project which is owned by him, known as the Duck Creek Irrigation project. The impounding dam near the mouth of Duck creek is to be raised in height and this will increase the area supplied with water to over 800 acres. The storage reservoir is fed by the waters of Duck creek.

The Secretary of the Interior has approved the modification of a contract now in force between the United States and the city of Nampa, Idaho, whereby the latter is permitted to reduce the amount of water now being supplied by the government from 420 inches to 220 miners inches. The Reclamation Service is authorized to execute a new contract for the season of 1913 with the authorities of Nampa.

The Columbus Improvement Association of Columbus, N. M., have undertaken a reclamation project, which, if successfully carried out, will mean the reclamation of hundreds of acres of desert land within the vicinity of Columbus.

Nearly 2,000 acres of land is involved in the present plan, and as the project advances, other land adjacent will be taken in for irrigation. A water right has been secured from the government and a dam erected and ditches are now being constructed to carry water over the various tracts of land.

Eastern capital is interested in the Horseshoe irrigation project located near Glendo, Wyo. The Horseshoe Development Company has been formed and application has been made for the segregation of 22,000 acres in the district. The irrigation system will embrace a number of reservoirs and dams. Sidney E. Bartlett, of Cheyenne, is the engineer for the project.

The large dam on the Belle Fourche, South Dakota, irrigation system has been repaired, and, according to the statements of the engineers, is now stronger than before the damage inflicted this spring.

Irrigation on a small scale is proving successful on the Carl Stevenson ranch near Junction City, Kan.

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I wish to dispose of my 880 acres of river bottom land on the Rio Grande river in the San Luis Valley. All fenced and crossed fenced. Three and one-half miles of woven wire. All in artesian well district. Full water rights for laterals and ditches.

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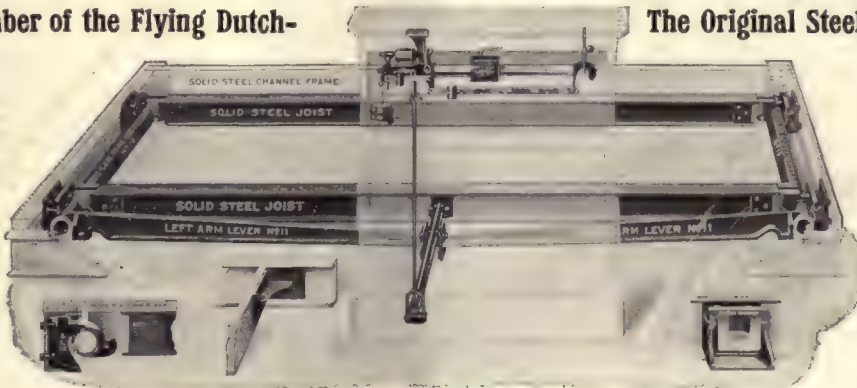
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(Continued from page 336.)

a high level of prices, which is due mainly to the growth of cities, and farmers are enjoying the greatest money making period that they have ever known. Such a state of affairs must naturally continue so long as the non-producing element develops faster than the agricultural class.

Crops are uniformly good, with the exception of winter wheat, which falls below the average owing to winter killing in certain localities. The cotton states report an encouraging outlook, and in the rest of the country there will be a large output of grain, tobacco, live stock and fruit, as well as many commodities of less importance but which tell their story of diversified and progressive farming. There is a large distribution of merchandise, with clear evidence that the buying is only proportionate to the consumptive demands of the public. The steel industry continues to lead all other interests in the extent of its gains over last year's volume of business.

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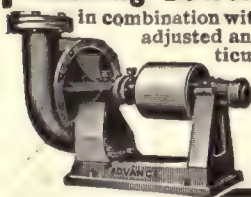
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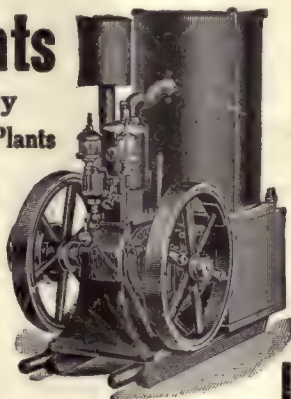
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GOOD COAL OUTPUT.

The production of coal in Tennessee in 1911 was 6,433,158 short tons, valued at \$7,209,734, according to a statement by Edward W. Parker, just made public by the United States Geological Survey. This was a decrease from the output of 7,121,380 short tons, valued at \$7,925,350, in 1910, of 9.66 per cent in quantity and 9 per cent in value. Notwithstanding this rather notable decline, the output in 1911 was larger than that of 1909 and exceeded that of any preceding year except 1907. In a preliminary review of the coal trade of 1911 published in the closing week of that year, Mr. Parker stated that the production of Tennessee, as of Alabama, was about 10 per cent less than in 1910. The reliability of the information on which these estimates were based is attested by the complete returns. The lessened production in 1911 is not indicative of any decline in the coal-mining industry of the state, for comparison with a series of preceding years shows that the tonnage was normal, and there was a small advance in the average price. Tennessee, in common with the other states of the Appalachian region, benefited by the long strike among the miners in the Mississippi Valley States in the spring and summer of 1910, and production was unusually stimulated. The decreased tonnage in 1911 was simply a return to normal conditions.

Nearly 25 per cent of the entire decrease was in the quantity of coal made into coke, which declined from 615,558 tons in 1910 to 461,963 tons in 1911. The quantity of coal made into coke represents considerably less than 10 per cent of the total output. In 1911 the number of men employed in the Tennessee mines was 10,703. The average production for each employe was 601 tons; the average daily production per man was 2.59 tons.

Tennessee's record with regard to the methods employed in the mining of coal is fair. Operators producing about 80 per cent of the total output in 1911 reported that 43.9 per cent of their total production was mined by hand, 15.6 per cent was undercut by machines, and 40.5 per cent was shot from the solid. It may be inferred, therefore, that nearly 80 per cent of the coal produced was mined before being shot or wedged down.

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NEW RAILROAD RUMORS.

Rumors of new railroads are in circulation in Northwestern South Dakota. Minneapolis and St. Louis surveyors are reported to have been at work in the neighborhood of Isabel, in Dewey county. The old survey is being followed from LeBeau, the Missouri river near terminus of the road, crossing the Moreau river near White Horse. From White Horse the line runs in a westerly direction, passing within a few miles of Isabel and continuing west to Pickerville.

Another rumor is to the effect that the Northern Pacific will build its long contemplated extension southward from Fort Yates, N. D. One rumor is to the effect that the extension will be built to Mo-bridge, but another is to the effect that the road will be built on the western side of the Missouri river, instead of the eastern, and will make a loop through northwestern South Dakota in an effort to shorten the Northern Pacific line to the coast, to meet the strenuous competition of the Milwaukee road.

American farmers have much to learn, if they ever decide that it is desirable to learn it, with regard to intensive cultivation.

United States Consul Robert Frazer, Jr., of Valencia, Spain, has written to the State Department to the effect that in the Province of Valencia families subsist on the produce of four-tenths of an acre of land and that as many as 160 families live on 100 acres. The cultivation is by hand, little machinery being used, and the land is officially valued at an average of \$656 an acre. Rain-fall being insufficient, irrigation is necessary, but the production is enormous, amounting to more than 1,000,000 metric tons of oranges, olives, grapes, and other crops.

In view of such figures as these one is tempted to ask why there is any cry of a land famine? The Government is still giving away land for nothing, and in some localities it is giving the homesteader 320 acres, while in others it has reduced the period of time required to get title to a homestead to three years.

Undoubtedly the rush to Canada is largely misguided. It has been induced by active advertising on the part of Canada, and by more liberal regulations for the taking up of lands. Many Americans who have precipitately crossed the border are likely to come back again as soon as they can do so without loss, and they will be the better for their experiences. Moreover, they will have learned that the distant fields always look greenest, and that Uncle Sam still has as good lands as are being given away by any other government.

Send \$2.50 for The Irrigation Age 1 year, and the Primer of Irrigation

ANNOUNCEMENT.

Mr. Harry A. Storrs has associated himself with the Edmund T. Perkins Engineering Company, Chicago, Ill., as consulting electrical engineer.

Mr. Storrs is of New England birth and education. His engineering education includes post-graduate work at Columbia College, New York, and several years as professor of electrical engineering in the University of Vermont. In practical engineering, his experience covers commercial installations in Vermont, Colorado and California, as well as government construction work on the Atlantic Coast and in the Western states.

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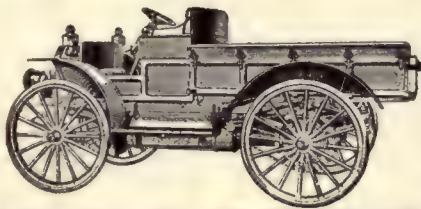
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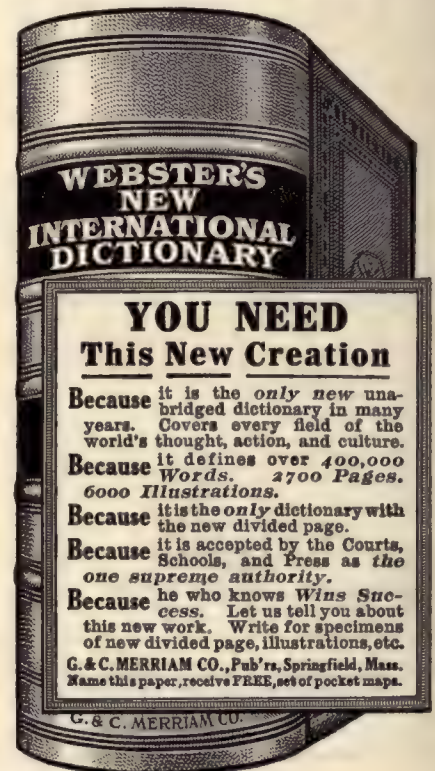
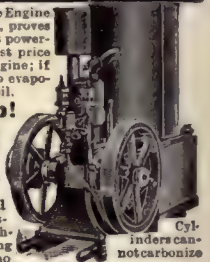
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The Maine Agricultural Experiment Station has issued under the above title Bulletin 198, which is the second of a series giving the results of spraying with fungicides and insecticides of the apple. The work of 1911 is preceded by a condensed account of similar experiments of the season of 1910. The 1911 experiments are discussed under two heads: Those carried on at Highmoor Farm, and co-operative experiment in the orchards of three practical fruit growers in the town of Greene. The results in both places were practically alike.

An appendix gives the latest formula for making the stock lime-sulphur concentrate, with the dilution table and directions for using the latter.

A copy of Bulletin 198 will be sent to any resident of Maine on request to Director Chas. D. Woods, Orono, Me. To non-residents of Maine the price is 10 cents, which must be sent in coin or other currency. Postage stamps are not accepted.



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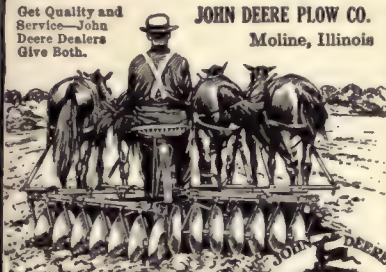
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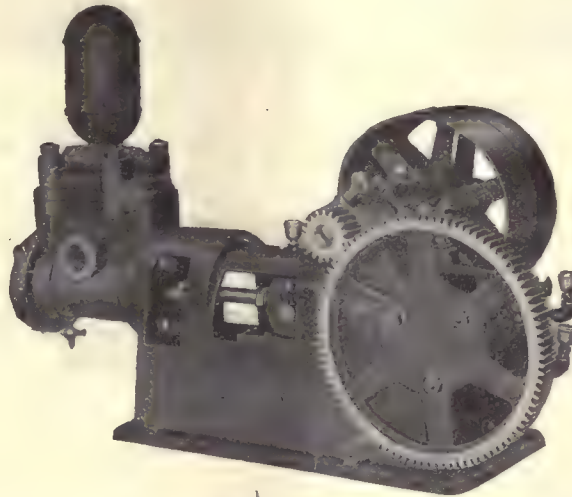
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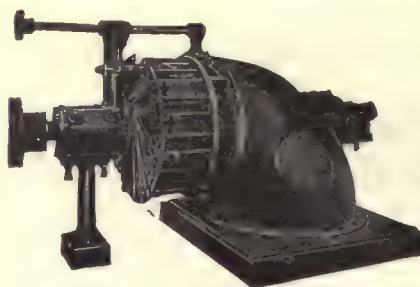
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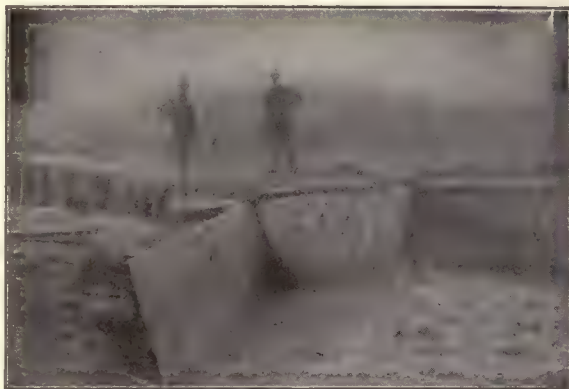
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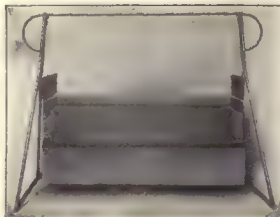


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THE IRRIGATION AGE

VOL. XXVII

CHICAGO, AUGUST, 1912.

No. 10

THE IRRIGATION AGE

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D. H. ANDERSON
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Old No. 112 Dearborn St.

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D. H. ANDERSON, Editor

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readers in all parts of the world. The Irrigation Age is 27 years
old and is the pioneer publication of its class in the world.

Wonderful Development in Idaho Orchards.

That Idaho will eventually become the
greatest fruit state in the Union is
shown by the number of apple and fruit
trees which have been planted there
during the past few years. While visit-
ing the Salmon River country recently,
the editor of this journal spent a day on the Twin Falls
Deep Creek Orchard Company's tract west of Hollister.
This company, with headquarters in Twin Falls, has de-
veloped an orchard which should be a tremendous money
maker in a few years. They have already set out 64,000
apple trees of fine varieties, and contemplate doubling
that area within the next two or three years. Further
information concerning this project will be found else-
where in our columns.

Low Rates to National Irrigation Congress.

The National Irrigation Congress, which
is to meet in Salt Lake City September
30, held its first meeting in that city
September 15-17, 1891. This year it re-
turns to the city of its birth to hold its
twentieth annual meeting. While this
is but its twentieth meeting, it is the twenty-first anniver-
sary of the organization of the congress and it is particu-
larly appropriate that Salt Lake City be allowed an oppor-
tunity to entertain its members. Special railroad rates
and tourist fares have been made applicable to the com-
ing meeting by all interested railroads. Within certain
territory a special rate of one fare for the round trip
will be available. From greater distances one and one-
third fare rates have been made for the round trip, with
liberal stop-over and return privileges.

Bumper Crops In Idaho.

On a recent trip through Idaho and Utah the editor of IRRIGATION AGE found agricultural conditions materially improved over those of last year—in fact, the crops throughout Utah and Idaho as well as Wyoming are in much better condition and all those who are familiar with irrigation affairs predict a bumper crop in these regions.

There is some question as to the ability of the railways to handle the immense crops which are raised throughout the Twin Falls and other districts in Idaho. It is stated that the officials will find difficulty in securing cars to handle the crop, and this may materially hamper the farmer who has figured on turning his produce into cash. On the other hand, it will give the bankers throughout that section a chance to assist the settler by advancing money on grain and produce in storage.

It was learned on this trip that while there seems to be plenty of money lying in the banks, there is a strong tendency to hold it up pending the decision of political questions which now agitate the country. The word has evidently gone out from financial centers to country and city banks throughout the west to "go easy" until some fairly good solution has been arrived at concerning the political aspect of affairs during the next four years.

Twentieth National Irrigation Congress.

While in Salt Lake City recently the editor of IRRIGATION AGE met officials of the Twentieth National Irrigation Congress which is to be held in that city September 30-October 3, and he learned that a special effort is being put forth by the local officials to bring the largest crowd to Salt Lake City that has assembled there in its entire history. The congress, which will start on the 30th of September and finish its work on October 3, will be followed by the Semi-annual Conference of the Mormon Church, and this will bring a large number of people from all over the states of Utah, Arizona and Wyoming, as well as other adjoining states. Those who attend the Semi-annual Conference of the Mormon Church will, no doubt, take advantage of the special rates offered to the National Irrigation Congress and will spend a greater part of the week in Salt Lake City.

Another feature that will attract a great many visitors to the city is the state fair, which will be held in Salt Lake City during Congress week, hence it is fair to presume that Salt Lake City will entertain the largest number of outside visitors in its history. This will all tend to make those from outlying states familiar with the possibilities, not only of Utah, but Idaho and other western states through which they will travel in going to or from the Congress.

Those going from the east should make it a point to go out from Denver over the Union Pacific line and return via the Denver & Rio Grande, thereby affording an opportunity to see the various phases of irrigation, and at the same time enjoy the beautiful scenery along each of these lines.

It may be well to suggest that those who are going from the east extend their trip farther west and study the rapidly developing state of Idaho. This state has doubled its population during the past ten years, and there are many opportunities for money making in that state for those who are looking for new fields for investment.

American manufacturers of excavating machinery are rapidly gaining foreign patronage through the advertising columns of THE IRRIGATION AGE. The government of South Australia is buying machinery in this city in considerable quantities. S. McIntosh, director of irrigation and reclamation for the government, writes from Adelaide that one of the large ditching machines recently received from Chicago has reduced the cost of shifting soil from 36 to 6 cents per cubic yard. Several concrete mixers which were purchased here by Mr. McIntosh during his visit last winter have also served to materially reduce the expense of constructing dams, ditches and sluices.

The government of South Australia is pushing irrigation on a large scale for the benefit of agriculture. The director, Mr. McIntosh, who made a careful study of methods in the United States early this year, is an enthusiast on the subject and reports substantial gains in all kinds of crops as a result of water control.

Nearly all demonstrations of a public nature in South Australia are conducted by this gentleman, and the results are published far and wide. It is stated by machinery men in Chicago that Professor McIntosh has made the best demonstrations of the value of irrigation that are reported from any foreign country. The special merit of his work is that he applies it to the common farm crops—not specially to fancy products. His irrigated wheat lands are yielding 30 to 40 bushels an acre, against 15 to 25 bushels on non-irrigated soil. In vegetables and fruits the results are equally important.

Experts in this country and elsewhere are giving much attention to machinery for the economical construction of irrigation plants, and up to the present time Chicago manufacturers appear to lead all others. This claim is made by Professor McIntosh and is substantiated by S. V. Kadam, B. A., agricultural officer of Gwalior State, India, who also bought irrigating machinery and agricultural implements in Chicago a few months ago, after visiting factories in various parts of the country.

These gentlemen, who are the foremost experts of their respective states, advocate individual irrigation plants wherever farmers cannot avail themselves of the advantages of a general system. They tell of cases in which farmers have constructed cement reservoirs at an expense of a few hundred dollars and employed windmills or gas engines to keep them filled when rain is lacking.

Business like the sale of excavating machinery in Australia and India serves to illustrate the opportunity which is open to Americans in all parts of the world. The time is ripe for an aggressive campaign in the interests of our manufacturers.

What we should be doing to develop better commercial relations with South and Central America is an issue upon which many have spoken and written, with but little change in the existing situation. It is not because we fail to recognize the excellent opportunities for profitable trading afforded us in the countries below the equator. That circumstance is fully recognized. It is owing to our failure to go after the trade systematically and intelligently that our total commercial volume with South and Central America shows up so negligibly.

We have done next to nothing to develop these countries, while England, Germany and France have invested therein large amounts of capital, and as a result

enjoy extensive trading relations with them. Through this means our European rivals control many of the large private enterprises in South America, such as banks, railroads, steamships, etc., while our influence amounts to nothing.

Dissatisfaction in the Grand Valley, Colorado.

Much dissatisfaction is expressed by the citizens of western Colorado over the delay on the part of the United States Reclamation Service relative to the terms of the contract which the settlers on the land to be irrigated are asked to sign. When the United States government or the Reclamation Service undertakes an irrigation project the plan has been to secure contracts from land holders specifying their willingness to take water under the government project at a given sum per acre. These contracts have been forced upon the people under various projects where the water is used just as a private corporation would do in order to settle the question of the return to the government of the money expended on each project. It is said by the people in western Colorado that no corporation has ever offered such a contract as the one which the Reclamation Service has circulated for signatures in the Grand Valley.

Under this contract the settler would be helpless, so it is stated, as the government makes no promise to the settler as to when water will be delivered. The representatives of the Reclamation Service have not, so we are informed, been able to let the settlers know the ultimate cost of the water per acre. The price mentioned by the federal representatives varies from \$50 to \$70 per acre.

A correspondent for a western newspaper states that on other government irrigation works the ultimate cost of water has been two or three times the original estimates of cost, and that if the Grand Valley Highline canal shows a similar increase the water will be too expensive to use for irrigation. It is furthermore stated that the contract offered by the government puts upon the settlers the burden of determining their rights to the use of the water of the Grand River—in other words, this correspondent goes on to say that the government assumes no responsibility as to delivery of water.

It seems that the writer of the article referred to must be in error in this case, as there certainly should be some definite knowledge on the part of the Reclamation Service as to the rights of the settler in the matter of water taken from the Grand River, otherwise the whole project would be up in the air and it would place the settler in the position of a man who pays cash for a deed to property when he has no assurance that the deed will be of any value when delivered to him.

This correspondent goes on to say that the contract offered puts the settler absolutely under the control of the secretary of the interior. The settler who signs the paper agrees to obey without question anything that the present or any future secretary of the interior may tell him to do with reference to the use of water.

The statements of the correspondent are so unusual and extraordinary that one is inclined to the belief that he is exaggerating the condition.

In any irrigated country the water is its lifeblood, whoever controls the water controls the community, and the arid states recognizing this have passed laws which absolutely control private corporations, but the power is not granted the state against similar conditions offered

by the United States Reclamation Service. Furthermore, the delays in the construction of this project have been unusual and a great deal of complaint has reached us concerning the manner in which it has been handled.

Some years ago a private corporation offered to build this canal and agreed to have it complete in three years if the government would step out of the way, but this the officials of the Reclamation Service have not been fit to do. Several crops, so it is stated, could have been raised by this time by the land owners had the offer of the private company been accepted.

There are, no doubt, two sides to this case, but there must be some cause for complaint on the part of the settlers, otherwise we would not hear so much about it.

There are, no doubt, many in the valley who cling to the idea that a canal controlled absolutely by the government or a water users' association dominated by government officials, would be better than a private system.

When this work is finished there is no doubt that it will be more stable and last longer than any similar work which could be produced by private individuals, as the government does not usually "half do" its work. This is one reason why the expense is higher than would be encountered if the work was performed under private control.

Mr. Newell, the head of the Reclamation Service, has shown a tendency lately to handle these matters with much fairness and it is strange that a condition as described should be permitted to exist in the face of a strong demand for water and a desire for definite knowledge as to its cost.

Our correspondent in that section does not inform us as to what methods have been taken to remedy these conditions. No doubt the subject has been presented to the proper authorities at Washington or the local representatives in Colorado, with no apparent result so far.

If Mr. Newell could be induced to take this matter up personally there is no doubt that he would be inclined to assist the people under this system and it is the hope of all that he may go into the matter and do what he can for them.

GIVE EXTENSION TO THE FARMER.

Water users of the Fort Shaw unit of the Sun river irrigation project in Montana who were unable to pay the operation and maintenance charge due March 1, 1912, which amounts to \$1 per acre for irrigable lands, may receive water during the irrigation season of 1912 and have until December 1 to pay the charge, according to notices sent out by Samuel Adams, first assistant secretary of the department of the interior. The conditions under which this concession may be had follow:

"Every water user shall fully pay the unpaid balance, if any, of operation and maintenance charges for 1911 and prior years before any water is furnished for his land in 1912.

"Every such water user desiring such extension of time shall on or before August 15, 1912, make written application therefor to the project engineer, accompanied by his affidavit that he is unable to make such payment at this time and agreeing to make the said payment not later than December 1, 1912.

"For all persons to whom such extension is granted, the charge for operation and maintenance for 1912 shall be \$1.10 instead of \$1 per acre of irrigable land."

Send \$1.00 for 1 year's subscription to the IRRIGATION AGE and bound copy of THE PRIMER OF IRRIGATION. If you desire a copy of The Primer of Hydraulics add \$2.50 to above price.

The Twentieth National Irrigation Congress

A Word of Greeting from Chairman Snow

Greeting to Members and Delegates to the Twentieth National Irrigation Congress by Chairman Snow of Utah Board of Control:

As Chairman of the Utah Board of Control for the Twentieth National Irrigation Congress to be held in Salt Lake City, September 30th to October 3, 1912, I extend to you a cordial greeting and welcome in which I am sure all citizens of the State of Utah gladly join me.

Salt Lake City was the birthplace of the National Irrigation Congress twenty-one years ago and here also was the birthplace of Anglo-Saxon Irrigation sixty-three years ago. Our city and state have therefore good reason to be proud of the splendid accomplishments of the Congress, and our hope and purpose is to make the coming session the most interesting, impressive and instructive thus far held.

The State of Utah has provided many interesting features of entertainment for the officers, delegates and others who may come, while the officers of the Congress have arranged a program which includes some of the ablest speakers in the land, men of wide experience who have given the various vital subjects to be discussed much thought and in some instances a lifetime of endeavor.

For the consideration of these subjects we shall meet as a body of practical agriculturists—farmers if you please—who are seeking through the practical inter-

change of ideas to advance the economic conditions of our splendid country. Through organized effort we are also seeking to bring about conditions which will result in a more proper and thorough recognition from state and federal governments of our several lines of individual endeavor.

The vast achievements in the line of irrigation development constitute the history of the National Irrigation Congress and the writing of this history is but well commenced, therefore careful thought, well defined plans and practical execution should be our constant aim.

The earnest men who launched the work of the Congress and participated in its early deliberations probably had in the commencement but scant anticipation of the wide and beneficent results which have followed their effort, and if in the light of the past twenty years' experience the Congress shall fail of further high and broad accomplishments it will be due to a great and important duty poorly done. The future work of the Congress therefore calls for the practical and united effort of real unselfish men. That the good work may be continued with energy and determination and along well thought out lines to the end that our country as a whole may continue in prosperity, is my earnest wish.

(Signed) GEORGE A. SNOW,
Chairman, Utah Board of Control,
National Irrigation Congress.

ENTERTAINMENT FEATURES

Twentieth National Irrigation Congress

Entertainment features of the Twentieth National Irrigation Congress will be provided by Salt Lake City and the State of Utah on a scale that will make the Congress memorable in the history of the organization. In arranging the general plan of entertainment, however, the committees under the direction of the Utah Board of Control have sought first for appropriateness and the entertainment and amusement features will by no means be allowed to interfere with or detract from the broad economic purposes of the Congress.

One of the chief features for the opening of the Congress will be the electrical pageant and illuminated parade on the evening of September 30. All Utah will participate in this feature and adjoining states will also be represented by spectacular features in the line of floats. Plans for the pageant feature of entertainment outlined under direction of Douglas White, chairman of the committee on parades, provide for a series of floats which will represent with artistic grace and gorgeous effect the history of irrigation on the American continent. Then will follow a series of floats portraying with like effectiveness the practical results of the development of various sections of the West as brought about through the reclamation of agricultural lands. Variety and ingenuity of design with the experience of expert builders and electric illumination will combine in making the excellence of these features.

In connection with the illuminated parade the Mighty Wizard of the Wasatch will be escorted by a few hundred of his wards and this great mystical personage will deliver his message with proper pomp and ceremony. The Wizard, who is supposed to dwell in the remote canyons of the Wasatch mountains surrounding Salt Lake, has made only one or two state visits to the principality

over which he exercises kindly supervision but these state visits are incidents long to be remembered on account of their spectacular character.

The presentation of the Queen of Irrigation with her many maids of honor and attendants will be another feature of interest to those who know the beauty of the womanhood of the West. The Queen will open formally the first session of the Congress and, with her maids of honor, she will assume a prominent place in all of the events of the entertainment program.

Presentation of the famous Irrigation Ode, written by Mrs. Gilbert McClurg, under the personal direction of its composer, Professor J. J. McClellan, will be made at the opening session of the Congress at the Salt Lake tabernacle. This ode will be sung by the noted tabernacle choir, augmented to about 300 voices and accompanied by a special orchestra of 25 pieces in addition to the famous tabernacle organ—one of the largest in the world. The Irrigation Ode has been rendered at several sessions of the Irrigation Congress since its composition by Professor McClellan and the writing of the words by Mrs. Gilbert McClurg, so that it has come to be known as the official music of the Congress. The rendition this year under the personal direction of its composer and under conditions afforded by the place of meeting will result in a rendition that is expected to excel any previous one.

As outlined tentatively, the presentation of the Queen of Irrigation and her maids of honor will take place at 10 o'clock on the morning of September 30 at the formal opening of the Twentieth Congress. Then the rendition of the Irrigation Ode will follow, with a program that will include musical numbers by soloists of more than local fame. This session will be held in the tabernacle, a building with acoustics that are unsurpassed and having a seating capacity of nearly 10,000. Sessions of the Congress occupied with the business of the Congress exclusively will be held in the assembly hall adjoining the

tabernacle while the official headquarters of the officers and board of governors of the Congress will be at the Hotel Utah across the street. A reception and ball for delegates will be given Thursday evening, October 3.

The date for the Congress, September 30 to October 3, has been set to coincide with the Utah State Fair, whose dates are September 30 to October 5. The semi-annual conference of the Mormon church will open the day after the Congress adjourns. In arranging for the mammoth exhibit of products of irrigated farms of the West, the exhibits committee of the Congress has the full co-operation of the Utah State Fair board and the Congress exhibits will be shown in connection with the state fair. In this line, the interesting features of the state fair program will be added attractions to delegates and visitors to the Congress.

Already known as "The Center of the Solid West," Salt Lake and its immediate surroundings offer attractions aside from the special entertainment program that will make a visit of ten days or longer one of the most pleasant features of any western trip. Following the sessions of the Congress the visitor may take his choice

The exhibit features of the Congress will be shown in connection with the Utah State Fair and arrangements for this part of the Congress have been made in cooperation with the state fair board. The fair grounds are located nine blocks west of the meeting place of the Congress and street cars for the fair grounds pass the Temple Block.

Following is a list of the principal hotels of the city:

HOTELS OF SALT LAKE CITY

(European Plan. Cafe Service)

(Rates \$1.00 to \$3.00 a day, except the Utah, \$1.50 and up)
 Utah Hotel.....Main and South Temple
 Cullen Hotel.....33 West Second South
 Wilson Hotel.....28 East Second South
 Moxum Hotel.....State and Fourth South
 Semloh Hotel.....State and Second South
 Kenyon Hotel.....Main and Second South
 Grand Hotel.....Main and Fourth South
 Peery Hotel.....Third South and West Temple

The personnel of the National Irrigation Congress will be as follows: The officers of the Congress, the



Views in Salt Lake City, Utah.

between canyon resorts nestling amid the snow-clad peaks of the Wasatch mountains or the great Salt Sea only a few miles from the city. In the immediate vicinity of the city are numerous other pleasure resorts and amusement parks while side trips of a day's duration can be made to the great mining and smelting camps nearby.

In holding its twentieth session the National Irrigation Congress returns to Salt Lake, the place of its birth twenty-one years ago. The first session was held in Agricultural Hall which has long since given way to the march of progress and the twentieth session business sessions will be held this year in Assembly Hall on the famous Temple Block adjoining the business district of Salt Lake. The opening session of the Congress, at which the Irrigation Ode will be rendered, will be held at 10 o'clock on the morning of September 30 in the Tabernacle building, which has a seating capacity of nearly 10,000.

The meeting place of the Congress is the center of interest for tourists, across the street from the Hotel Utah and within three blocks of all of the principal hotels of the city. Street cars from all railway stations pass the gates.

President of the United States, the Vice President of the United States, members of the Cabinet, members of the United States Senate and House of Representatives, governors of states and insular possessions of the United States, members of federal, state and insular irrigation water and conservation commissions, state engineers and commissioners of agriculture and horticulture, the mayor of each city having a population of more than one thousand, executive committeemen, honorary vice presidents and members of the board of control of the Congress, chairmen of special and general committees, permanent delegates and delegates appointed under the provisions of the constitution. In addition to these delegates from states, counties, cities and towns, associations and colleges, all foreign governments are invited to send representatives to the Congress and the presence of visitors, including ladies, is invited.

Special railway rates and tourist fares will be on sale on all railroad lines interested and delegates and visitors will be able to procure tickets that will permit a liberal stop over at Salt Lake and allow for extensions to various points of interest in the West.

UTAH—THE HOSTESS STATE

Twentieth National Irrigation Congress.

Although business sessions of the Twentieth National Irrigation Congress will be held at Salt Lake, the capital city, September 30 to October 3, next, the whole state of Utah will act as hostess for the gathering of delegates and visitors to this great organization. Practically every county in the state is participating in the arrangements for entertainment of the Congress and the interest taken by the various communities of Utah in this gathering extends beyond the plans for providing for the comfort and convenience of the Congress as a body and caring for the accommodation and entertainment of the individual delegates and guests of the Congress.

Utah is proud as a state of being known as the pioneer irrigation state of the Union and the state pride as the hostess for the First National Irrigation Congress is a feeling in which every business man and agriculturist in Utah participates. The entertainment of the Twentieth Congress this year, however, marks the third session held in Utah, as this honor was accorded to Ogden in September, 1903, and three Utah men have served as president of the Congresses in other years.

Utah lies almost entirely in what is known as the Great Basin and her territory is also included in the arid to semi-arid belt where the cultivation of the soil de-

pends entirely on irrigation or on scientific conservation of moisture in methods of agriculture. The state is, generally speaking, a broad expanse of plains, mountain chains, elevated plateaus or benches, mesas and valleys which offer a variety of agricultural conditions which are scarcely to be duplicated in any other single state in the Union. Naturally a large area of the state can never be brought under the plow because of its rugged, mountainous character. Other parts of Utah are so situated that even with the development of scientific conservation and distribution of water to its fullest extent it will not be classed as irrigated land. Of these lands the "dry farmer" will look after his few million acres while the remainder will remain as Nature wills—possibly awaiting the further development of man, who may yet discover new uses for what is now regarded as the waste in Nature. It is this mountain territory, however, which gathers, stores and then distributes the water which is transforming the deserts into gardens and rewarding the intelligent industry of the farmer in a measure beyond the rosiest dreams of the agriculturist in the days when the growing of crops depended upon the whims of the weather in the distribution of rainfall.

Study of the first principles of geology is simply a matter of intelligent observation in Utah where the deep soils have been washed to valley and plain from the mountains. This process can be observed on all sides and the soils of many parts of the state can be traced to their sources by simply watching the process which removes the mountains with their richness to the valleys below. The rains, winds, frosts and suns of ages have spread this soil in blankets of great depth and wonderful fertility while the various elevations of valleys and plains afford variety of climatic conditions suited for a range of products from cotton to barley and northern apples to pomegranates.

Utah's total area is 52,597,760 acres, but of this area only about three per cent is under cultivation and little more than 1,250,000 acres have yet been brought under irrigation in this, the pioneer state of irrigation. Irrigation enterprises projected, some of which are already in various stages of construction, will add at least 50 per cent to the irrigated area of the state and with the completion of these Utah will have only started to utilize its comparatively small acreage available for irrigation at reasonable cost. These comparisons furnish subjects for thought and discussion among those most interested in the advancement of the industrial welfare of the state and also explain why Utah is vitally interested in the broad principles and aims of the National Irrigation Congress.

Latest statistics on farm lands of Utah show that there are approximately 22,000 farms in the state, while the average irrigated farm is under 40 acres and decreasing in size each year. This indicates the trend towards more intensive cultivation and, although the irrigated acreage of the state is sure to continue its rapid increase, agricultural experts declare that the raising of grain and similar products on irrigated lands in Utah will diminish rapidly and eventually be superseded entirely by crops requiring more intensive cultivation and yielding greater returns for labor.

Some of the larger irrigation projects of the state are within easy reach of Salt Lake and many visitors to the Congress will avail themselves of the opportunity to look over the operations of the Strawberry project now nearing completion under direction of the United States Reclamation service.

The canal system maintained and operated by Salt Lake City is also a feature that will be of general interest to practical irrigationists. This system includes a pumping station on Utah lake, 30 miles from the city, and a canal which brings lake water to the bench lands above the city where it is exchanged with the farmers for the pure flow of the canyon streams which furnish the city mains with about 34,000,000 gallons a day.

The University of Utah, located at Salt Lake, will be another point of interest for delegates and visitors to the Congress, while many will also wish to visit the Agricultural College of Utah at Logan and the various experimental farms in other parts of the state operated by the extension division of the college.



Presidents of National Irrigation Congress.

SALT LAKE, HOSTESS CITY FOR THE TWENTIETH NATIONAL IRRIGATION CONGRESS.

By Carl Williams

Press Representative, Utah Board of Control.

Salt Lake, the "Hostess City" for the Twentieth National Irrigation Congress, will take special pride, on September 30, in welcoming the organization back to the place of its birth for the celebration of its twenty-first birthday. It was at the Utah capital that the first session was held September 15 to September 17, 1891. Although no meeting was held in 1892 and the session of 1901 was also omitted, there have been meetings each year, with these exceptions, and the organization which began in a small way to foster the nation-wide movement for the reclamation of lands has increased in strength and influence steadily.

Salt Lake, especially fitting as the place for the meeting of the Congress on the occasion of its attainment of its "majority," is also well selected inasmuch as the first irrigation work attempted by white men on the American continent was done at Salt Lake and these ditches constructed by the pioneers who settled the valley of the Great Salt Lake in 1847 watered lands within a few hundred yards of the hall in which the business sessions of the Twentieth Congress will be held.

Although in many ways the development of Salt Lake City has been along lines that apply generally to the larger cities of the West, there are features of its growth that have been closely allied with the development of irrigation in Utah and surrounding states and these peculiarities in themselves are closely allied to the importance of the objects for which the National Irrigation Congress was organized and to which the organization owes its very existence. Known first as a trackless and worthless waste, then as a land of meager agricultural possibilities, Utah came to be known a few years ago as a state which depended almost entirely upon its mineral wealth for its development and, likewise, the advancement of Salt Lake City depended entirely on these mineral resources. Then came a renewal of activity along lines promulgated by the National Irrigation Congress and Utah, although gaining steadily in mineral production, has again entered the column of states which are generally classed as those in which agriculture is the chief source of wealth.

It was this condition as foreseen by Wm. Smythe, "Father of the Congress," Hon. Arthur L. Thomas, then territorial governor of Utah, William Nelson and other prominent citizens of Utah, that led them to plan the organization of the men who were making the West into a body which would have for its chief object the scientific investigation of methods for the reclamation of lands by irrigation and the formation of a platform on which the business men of the country who realized the importance of this particular line of development might stand effectively. These men, realizing the importance of irrigation to the development of the entire West, realized at the same time that only through co-operative effort could real results be attained with any degree of celerity and they were likewise strongly of the opinion that the citizens of the country east of the Mississippi river could be brought to a realization of the national importance of irrigation only through an organization that should be national in its scope. Discussions of ways and means followed and the call for the first National Irrigation Congress as issued by the territorial governor of Utah followed.

Salt Lake, the hostess city for the 1912 Congress, was long regarded as a city of peculiarities and chiefly noted as the mecca for a religious people holding to strange beliefs and customs. In recent years, however, Salt Lake has come to be known as a thriving metropolis holding a commanding position at the center of a vast territory and growing at a rapid rate to keep up with the commercial demands, not only of the state of Utah but of the entire intermountain region.

Mining and agriculture have thus worked together in the development of Utah and its capital city and, although the balance of power or importance may swing from one side to the other and thus continue the rivalry among those following different branches of industry, the condition now recognized as permanent in Utah is that the continued growth and prosperity of the intermountain

region is the foundation for the individual growth of Salt Lake City and that the development of irrigation in this region will be the chief factor in the growth of the city for years to come.

One of the old "peculiarities" of Salt Lake as pointed out to tourists and remarked by thousands was the irrigation system covering the entire city, utilizing the sides of the streets for ditches. In some parts of the city these mountain brooks are still to be seen but most of them have given way to the needs of a greater population and more systematic and scientific use of the city's water supply. Thus, instead of the picturesque waste of the water from four or five nearby canyons, Salt Lake with its population in excess of 100,000 has an abundant supply of the purest water while utilizing no more than the minimum flow of the canyons. Recent steps towards the conservation of flood waters through the development of natural reservoirs in connection with the municipal water works system have in view the future growth of the city rather than present needs.

Some of the characteristic features of Salt Lake that will be noted by delegates and visitors to the Congress are worthy of passing mention. As to the old historic features, including the Mormon temple and Tabernacle and other spots closely allied with the religion of the pioneer settlers of the city, it may be said that they are still spots of interest to the hundreds of thousands



Presidents of National Irrigation Congress.

of tourists who visit the city each year and delegates to the Congress will not fail to see and admire these attractions. In early days these spots were perhaps rightly regarded as the beginning and the end of the wonders of the city from the standpoint of the tourist. Today they may be the beginning of interest to the tourist and visitor but the end is only measured by the time the visitor may spend or by his appreciation of scenes of artistic beauty or features of industrial and commercial importance.

Salt Lake City, with its far-famed temple has also one of the finest, costliest and most artistic Catholic cathedrals in the West and, besides the other interesting and picturesque buildings of the Mormon church, Salt Lake has scores of church buildings representing about twenty other denominations of religious belief. Besides the Great Salt Lake—that marvel of nature whose waters are nearly one-quarter salt—the city has parks and playgrounds for young and old at various locations throughout the city and adjoining the corporate limits. Nearby canyons offer scenic wonders regarded by many as potent arguments in support of the "See America First" movement even when compared with Switzerland's renowned sights and the location of the city, surrounded by peaks of massive grandeur and brilliant coloring is in itself a sight worth miles of travel to view. Salt Lake has the University of Utah and the government reservation of Fort Douglas adjoins.

PROGRAM

Twentieth National Irrigation Congress

Final decision on all features of the regular program for the Twentieth National Irrigation Congress to be held September 30 to October 3, remains with the National Executive Committee, who will meet at Salt Lake a few days before the opening session and arrange the schedule of speakers who will present the chief topics for discussion. A general outline of the program and amusement and entertainment features has been outlined by the Utah board of control, however, and this, with the tentative outline approved by the National board of governors at their last meeting, gives assurance that the program will be one of the most interesting of the Congress.

The chief subjects for discussion, which are included by the principles which the National Irrigation Congress advocates, will be as follows:

- Irrigation of the Great West.
- Storing of the Floods.
- Measurement of Streams.
- Scientific Investigation of Irrigation Projects.
- Proper Safeguarding of Irrigation Securities.
- Enactment of Proper Working and Uniform State Irrigation Laws.
- Preservation of the Forests.
- Opportunity to Build New Homes.
- Heeding the Call of the Landless Man for the Manless Land.
- Elimination by Law of Fraud in Connection with the Location and Sale of Land.
- Co-operative Effort of Government and State Immigration Officials.
- Close Co-operation of State Engineers.

The ablest speakers of this and other countries will lead in the discussion of these and other topics and many others will come prepared to take part in the free and democratic exchange of views on questions of vital importance to the agricultural development of the West.

The first session of the Congress will open at the famous Salt Lake tabernacle at 10 o'clock on the morning of September 30. This session will include addresses of welcome by Governor William Spry of Utah and Samuel C. Park, mayor of Salt Lake, with responses by officers of the Congress. The presentation of the Queen of Irrigation attended by her maids of honor will be another important feature of the opening session and the Queen of Irrigation will formally open the Congress. At this session the "Irrigation Ode," words by Mrs. Gilbert McClurg, music by Prof. J. J. McClellan, will be rendered by a chorus augmented from the tabernacle choir and instrumental and vocal soloists of more than local fame will add to the entertainment.

On the evening of the opening day will take place a grand parade and electrical pageant which will undoubtedly be one of the best of its kind ever seen in the West. This will be followed by a reception tendered delegates and visitors at the Salt Lake Commercial Club.

Morning and afternoon sessions of the Congress will be held either in the tabernacle or the assembly hall adjoining. The program for the last day will include formal inspection of the exhibits of irrigated farm products and the awarding of a large list of prizes to successful exhibitors, with a ball and reception to delegates in the evening.

DEL NORTE, COLORADO.

The town of Del Norte, located on the western side of the San Luis Valley, is the county seat of Rio Grande County and is situated on the banks of the Rio Grande Del Norte. It has applied the principles of municipal ownership to its electric light and water plant. Water for irrigation purposes is obtained from the Rio Grande River and its tributaries, the rights being based upon the earliest priorities.

The potato has proven itself to be the most profitable crop of the territory immediately tributary to Del Norte, yielding from 100 to 500 bushels to the acre, but the range alfalfa, small grain, vegetables, fruits, live stock, dairying and poultry raising are important industries in the Del Norte District.

Two large storage reservoirs are being built on the Rio Grande west of Del Norte which will water thousands of acres and more under irrigation.



Officers Twentieth National Irrigation Congress.

MEETING PLACES AND LIST OF OFFICERS of the

National Irrigation Congresses—1891-1912.

First Congress—1891.

September 15-17.

Salt Lake City, Utah.

C. C. Wright, California.....President

Gov. Arthur L. Thomas, Utah.....Ch. Ex. Com.

Wm. E. Smythe, San Diego, Cal.....Secretary

1892.

No meeting of the Congress.

Second Congress—1893.

Los Angeles, Cal.

J. S. Emery, Lawrence, Kan.....President

Wm. E. Smythe, San Diego, Cal.....Ch. Ex. Com.

Fred L. Alles, Los Angeles, Cal.....Secretary

Third Congress—1894.

Denver, Colo.

Elwood Mead, Cheyenne, Wyo.....President

Wm. E. Smythe, San Diego, Cal.....Ch. Ex. Com.

Fred L. Alles, Los Angeles, Cal.....Secretary

Fourth Congress—1895.

Albuquerque, N. Mex.

Geo. L. Cannon, Salt Lake City, Utah.....President

E. R. Moses, Great Bend, Kan.....Ch. Ex. Com.

Fred L. Alles, Los Angeles, Cal.....Secretary

Fifth Congress—1896.

Phoenix, Ariz.

C. B. Boothe, Los Angeles, Cal.....President

E. R. Moses, Great Bend, Kan.....Ch. Ex. Com.

Jas. H. McClintock, Phoenix, Ariz.....Secretary

Sixth Congress—1897.

Lincoln, Neb. (No Proceedings Printed.)

C. B. Boothe, Los Angeles, Cal.....President

E. R. Moses, Great Bend, Kan.....Ch. Ex. Com.

F. J. Mills, Boise, Idaho.....Secretary

Seventh Congress—1898.

Cheyenne, Wyo.

Jos. M. Carey, Cheyenne, Wyo.....President

Jos. M. Carey, Cheyenne, Wyo.....Ch. Ex. Com.

O. E. McCutcheon, Saginaw, Mich.....Secretary

Eighth Congress—1899.

Missoula, Mont.

Dr. S. B. Young, Salt Lake City, Utah.....President

C. B. Boothe, Los Angeles, Cal.....Ch. Ex. Com.

H. B. Maxson, Reno, Nev.....Secretary

Ninth Congress—1900.

November 21-24.

Chicago, Ill.

Elwood Mead, Cheyenne, Wyo.....President

Geo. H. Maxwell, Chicago, Ill.....Ch. Ex. Com.

H. B. Maxson, Reno, Nev.....Secretary

1901.

Buffalo and Colorado Springs selected. No Congress held at either place.

Tenth Congress—1902.

Colorado Springs, Colo.

Thos. F. Walsh, Washington, D. C.....President

C. E. Wantland, Denver, Colo.....Ch. Ex. Com.

H. B. Maxson, Reno, Nev.....Secretary

Eleventh Congress—1903.

September 15-18.

Ogden, Utah.

W. A. Clark, Butte, Mont.....President

Fred J. Kiesel, Ogden, Utah.....Ch. Ex. Com.

H. B. Maxson, Reno, Nev.....Secretary

Twelfth Congress—1904.

El Paso, Texas.

W. A. Clark, Butte, Mont.....President

C. B. Boothe, Los Angeles, Cal.....Ch. Ex. Com.

A. W. Gifford, El Paso, Texas.....Secretary

Thirteenth Congress—1905.

Portland, Ore.

Gov. Geo. C. Pardee, Oakland, Cal.....President

C. B. Boothe, Los Angeles, Cal.....Ch. Ex. Com.

Tom Richardson, Portland, Ore.....Secretary

Fourteenth Congress—1906.

Boise, Idaho.

September 3-8.

Gov. Geo. C. Pardee, Oakland, Cal.....President

Montie B. Gwinn, Boise, Idaho.....Ch. Ex. Com.

H. B. Maxson, Reno, Nev.....Secretary

Fifteenth Congress—1907.

September 2-7.

Sacramento, Cal.

Gov. Geo. Chamberlain, Portland, Ore.....President

W. A. Beard, Sacramento, Cal.....Ch. Ex. Com.

D. H. Anderson, Chicago, Ill.....Secretary

Sixteenth Congress—1908.

September 29—October 3.

Albuquerque, N. Mex.

F. C. Goudy, Denver, Colo.....President

F. C. Goudy, Denver, Colo.....Ch. Ex. Com.

B. A. Fowler, Phoenix, Ariz.....Secretary

Seventeenth Congress—1909.

August 9-14.

Spokane, Wash.

Geo. E. Barstow, Barstow, Texas.....President

W. A. Beard, Sacramento, Cal.....Ch. Bd. Gov.

B. A. Fowler, Phoenix, Ariz.....Secretary

(Continued on page 373.)



Board of Governors, Twentieth National Irrigation Congress.

The First National Irrigation Congress
IN 1891 AT
Salt Lake City

By ARTHUR HOOKER, Secretary National Irrigation Congress

Shrewdness and determination shown by the men who made up the first irrigation congress at Salt Lake in 1891 amounted almost to the ability to prophesy the great work to be accomplished by the organization in the succeeding twenty years. Paramount questions of agricultural development in the West were discussed by representative men of the West and the "Salt Lake Platform" as adopted by the first congress September 17, 1891, stands today as an interesting record of the work the organizers of the National Irrigation Congress had in mind in its earliest days. The "Salt Lake Platform," as adopted and published in the proceedings of the first congress is as follows:

"Resolved, That this Congress is in favor of granting in trust, upon such conditions as shall serve the public interest, to the States and Territories needful of irrigation,

all land now a part of the public domain within such States and Territories, excepting mineral lands, for the purpose of developing irrigation, to render lands now arid, fertile and capable of supporting a population.

"Resolved, That it is the sense of this convention that the committee selected to propose and present to Congress the memorial of this convention respecting public lands, should ask as a preliminary to the cession of all the land in the territories in accordance with the resolutions of the convention, a liberal grant to said Territories and States to be formed therefrom, of the public lands to be devoted to the public school purposes.

"Whereas, Large areas of arid lands and semi-arid lands, situated upon the great plains of the Dakotas, western Nebraska, Kansas and Oklahoma were settled upon in good faith, by homeseekers, under the supposition that they were entering agricultural lands and,

"Whereas, The settlers upon such lands have expended much time and labor upon the same; and paid into the United States Treasury therefor many millions of dollars, only to discover that irrigation, to a greater or less extent is necessary in making homes for themselves thereon; therefore, be it

"Resolved, That the representatives of all the States and Territories directly concerned in irrigation, do hereby pledge their unwavering support to the just demands of such settlers, that the general government shall donate at least a portion of the funds received from the sale of such lands towards the procurement of the means necessary for their irrigation.

"Resolved, That this Congress heartily endorse the irrigation work of the Agricultural Department of the National Government in the collection and dissemination of information, especially its admirable progress covering the whole field of irrigation development, and that it favors large appropriations for this work hereafter."

This "Salt Lake Platform" is regarded generally as being the forerunner of the United States Reclamation Service and of the Carey act, which are representative of the effective interest taken in irrigation by the Federal government that has resulted in the reclamation of millions of acres of the best lands in the West, which could not have been brought under cultivation within a century without government aid as outlined. General revision and improvement in the homestead laws affecting lands in the states where irrigation is necessary or important has followed the recommendations of the Irrigation congress from year to year. To many minds, however, the most significant achievement of the Congress has been in bringing about the general awakening of the East to the importance of the West and the necessity for national recognition of the needs of the Western states.

This better understanding between the East and West regarding measures for the agricultural development of the entire country has been brought about through the free and open discussions of the Irrigation Congress in which eastern representatives and men of influence in National affairs have taken part. Another feature of importance in the work of the Congress has been the affording of an opportunity for concentrated effort on the part of those who have been most active in the development of western irrigation. Broad and general ideas have been formulated, discussed and revised through the work of the Irrigation Congress in a manner which has insured their successful presentation as national issues.

Of special interest at this time is the outline of the call for the first Congress issued by Governor Arthur L. Thomas of Utah who, in his welcoming address to the delegates at Salt Lake September 15, 1891, said:

"The Congress is called for the purpose of hastening the reclamation of arable arid land, so far as possible, and for the purpose of petitioning Congress to cede to the states and territories the arid lands within their borders, for the purpose, first, of reclaiming the same; second, in aid of the public schools; and, third, for such other public purpose as the Legislative Assemblies of the states and territories may respectively determine."

The many ideas of the representatives of some sixteen states who met at the first session of the Congress were at variance regarding details but the general movement met with a response that was practically unanimous and differences over details vanished.



Governors of Irrigated States.

"KINNEY ON IRRIGATION AND WATER RIGHTS"

Second Edition

1912

To be Published by Bender-Moss Company, Law-Book Publishers, San Francisco, California.

Books to be ready for Delivery October 1, 1912.

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INCIDENTS IN DEVELOPING IRRIGATION WITH LAKE MUCK.*

C. R. SANDVIG, BELGRADE, MINN.

So far as I know I am the originator of dredging muck to irrigate with, instead of just using water. The jobbers who sold me the pump and the manufacturers who made it both expressed surprise when they were informed that I had used one of their small pumps for dredging, and they promptly asked for information as to how I had succeeded in dredging successfully with such a small pump. As a small pump may be a rather indefinite term, it may be of interest to know what the manufacturers mean by a small pump in this instance.

A speaker made the statement at the last annual meeting that he knew somebody who had spent thousands of dollars on irrigation devices and made a failure of it. They must have invested in a big pump. My pump cost something less than \$65. The power, a second-hand, twelve-horse steam threshing machine engine, which so far has worked as good as new, cost \$100. The pipes are old 4-inch boiler flues, which are just as serviceable and far more convenient than standard pipes and cost \$1 per 18-foot lengths. The couplings are short scraps of standard pipes bought from scrap iron dealers for one cent per pound. The joints are made by slipping the boiler flues inside of the standard pipes like a stove pipe joint. The capacity of this outfit is 260 gallons per minute, or a little over one ton of water for every sixty seconds, or, as an ordinary

old-fashioned kerosene barrel holds fifty-two gallons, it would amount to just five such barrels filled to the brim with muck and water dumped on the orchard or garden sixty times an hour.

One of the pumps made by this firm, though not the largest, has a capacity of 35,000 gallons per minute, which, in other figures, would be 8,886 tons of water an hour, or 673 barrels a minute. Such a pump with complete equipment would cost several thousand dollars. But I would not recommend a pump with a capacity of nearly two and a half tons of water a second for irrigating the ordinary farm or commercial orchard in Minnesota, even in a year like 1910. Of course, these are not the common plunger or piston pumps that have now been used for a generation or more to replace the old oaken bucket, but the centrifugal pump, which has neither plunger nor valves and works like a cyclone. It is a pump used for special purposes and not very well known to the average man. I had accidentally come across one of these pumps at an exposition, and a view of its construction gave me the idea that with such



Hotel Utah, Salt Lake City.

a pump it should be possible to pump muck to irrigate with just about as easily as to pump clear water.

There are a number of centrifugal pumps made which I did not then know, but the exhibitor intimated that there were others in telling of the superiority of his own. However that did not matter at the time, for he convinced me right on the spot that though there might be others there were none other worth having. Later, after thinking it over some, and after coming away from the magnetic influence of the exhibitor of this particular pump, I became suspicious. For you can't sometimes most always tell when listening to a dealer talk about his goods whether to believe the very words he says or whether it may not sometimes be better logic to believe the very opposite. So I began to reason that possibly all other centrifugal pumps might be still better than his.

But where to find these pumps was another problem. The ordinary implement dealers knew no more about centrifugal pumps than they knew about the internal anatomy of mud turtles, which these pumps outwardly very much resemble. Even the catalogue houses with their twelve hundred pages of all kinds of merchandise did not list a single centrifugal pump. Memory is a peculiar machine,

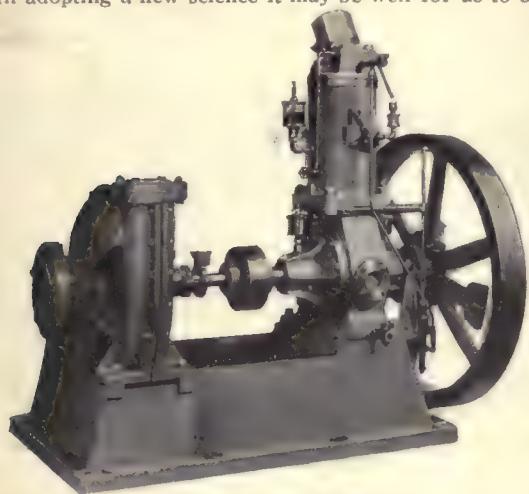
*From the "Minnesota Horticulturist," April, 1912.

and in this emergency I happened to remember that I had at some time read an article somewhere that was credited to IRRIGATION AGE, Chicago. IRRIGATION AGE was a strange name to me, and I did not know whether it was the peculiar name of a man, the title of a book or the name of a magazine devoted, as the name would indicate, to irrigation, but concluded that it was the latter, and, if a magazine devoted to irrigation, reasoned that very likely it would carry advertisements of centrifugal pumps. So I wrote a letter and addressed it to this mysterious name, IRRIGATION AGE, Chicago, asking for a sample copy and inclosing a quarter with the request that they send me a list of firms who might have advertised centrifugal pumps in their magazines in times past, but whose advertisements might not happen to appear in the current issue.

My guess proved correct. IRRIGATION AGE was a magazine. A sample copy arrived, but no letter, and I really felt slighted. A couple of advertisements of centrifugal pumps appeared in the magazine, but having determined to investigate and find the very best centrifugal pump made, I was not satisfied. A couple of days later, however, a couple of letters arrived from manufacturers of centrifugal pumps, telling me that IRRIGATION AGE, Chicago, had notified them that I was in the field for a centrifugal pump and that catalogues were being mailed under separate covers. The next day three or four catalogues of centrifugal pumps were received, and more letters from dealers telling me that IRRIGATION AGE, Chicago, had written them that I wanted a centrifugal pump and that catalogues were being mailed under separate covers. The next day there were some more, and for a week or more nearly every mail brought some catalogues of centrifugal pumps and letters from jobbers and manufacturers telling me that IRRIGATION AGE had notified them that I was in the field for a centrifugal pump and that catalogues were being mailed under separate covers.

My curiosity was fully satisfied, and I doubt if there was a centrifugal pump made or sold in the United States of which I did not receive a catalogue at that time. My suspicion proved correct, all these makes were really better than the pump I had first seen at the exposition. This list of catalogues gave me a splendid opportunity to pick out a pump for pumping muck. Some of the catalogues also contained some very valuable and some rather startling information. One item is of special importance. The pump I selected was provided for connecting to a 3-inch discharge pipe. Without knowing more, I would certainly not have invested in more than 3-inch pipes. The friction of the 260 gallons per minute through 100 feet of 3-inch pipe laying on the level would require as much power as to lift the water seventeen feet straight up, and as there were 700 feet of pipe the total friction alone would have been equal to raising the water 119 feet in addition to the actual lift of about 20 feet—had I not provided larger pipes.

In adopting a new science it may be well for us to bear in



Morris Centrifugal Pump.

mind that there may be much about it for us to learn. In the papers read on irrigation at the last annual meeting I saw where one man failed to get results and even damaged his pump because he had not made proper pro-



Secretaries of the National Irrigation Congress.

vision for friction and in using a piston pump had not provided an air cushion, when a neighbor came along and told him what was wrong. Had not that neighbor come along at the right time with the right information one of our leading horticulturists might have joined the list of those who declare that irrigation is not practical. And had it not been for selecting a pump from the great number of catalogues with which IRRIGATION AGE, Chicago, caused me to be flooded instead of buying the first centrifugal pump that I had seen, and for some of the hydraulic information contained in those catalogues, I should no doubt never have succeeded in developing irrigation with muck.

After selecting my pump I found some trouble with the other dealers who had sent me catalogues, for they all wanted to sell me a pump. My embarrassment was very similar to that of a friend of mine at Lake postoffice, Idaho. Peter had reached the age and position where he naturally did not like to "batch" it alone, but out there in the west there were not girls enough to go around, except a couple of old maids that nobody seemed to want, and Peter after going to see them a couple of times decided that he did not want them either. So he sent an advertisement to an eastern paper: "Wanted—lady correspondents." A number of girls replied, and Peter enjoyed all their letters very much and replied to them all the first time. But after a while he neglected all the rest of the girls to correspond with just one. However, the rest of the girls did not neglect to correspond

with him, and one of them when writing for the third or fourth time burst into poetry and wrote at the head of her letter:

"Oh, had I the wings of an eagle,
How soon would I fly to Idaho."

And Peter had to just sit down and write her that he did not want her because he had picked out one that he liked better. And that is just what I had to write some of those manufacturers in regard to their pumps.

When I sent the drawings and descriptions of my simple device for taking in muck continuously and keeping out stones to the jobbers they wrote back: "Your sketch is perfectly clear to us, and we must say that you have displayed great ingenuity in the installation of your pump." Which is perhaps true of my present device, but in looking back at some of the arrangements that I at first tried or experimented with I am now surprised at the ignorance I displayed, and if I finally succeeded in inventing a device that deserves commendation it is not due to any display of genius, but rather to the fact that after much experimenting there was finally nothing left to devise but something that would be simple, practical and efficient.

A description of this arrangement will no doubt seem as dry as a soda cracker sandwich with a smoked herring in it, but I assure you that there is nothing dry about it when in operation. It consists of a water-tight box with a lid on it, placed on the lake bottom, anywhere in the lake where it is far enough out to be clear from the beach sand and where the muck is deep enough, and connected with the pump on the beach with submerged pipes resting on the lake bottom. A short stub of pipe projects out of the top of the box and to this is attached an elbow, and to the elbow is attached a wooden pipe in short sections, and at the end of the wooden pipe is another elbow and to that is attached the intake pipe. The point of the intake pipe can therefore be lowered or raised, adjusting it to any depth of muck by swinging it on its elbow. The wooden pipe can at the same time be swung forward in a circle around the box as the muck is being cleaned up. When one circle has been completed another short section of the wooden pipe is inserted, when it is ready to swing around again, increasing the diameter of the hole. A raft is fastened to the pipes above the intake, the pipes holding the raft in position and the raft supporting the pipes at a proper depth. The wooden pipe is kept level and submerged a few inches. As movable joints are apt to leak a little the whole suction arrangement is submerged, either resting on the lake bottom or suspended near the surface. While a centrifugal pump is not particular as to what it drinks it is very sensitive to air. It will pump bullheads all right if they hold their breath until they pass the pump, but it is best to not experiment with devices that are likely to give the pump air.

A man works on the raft helping the soft muck to get started with a mortar mixer's hoe and keeping the intake pipe adjusted to the right depth and swinging it forward. There is no screen to clog with weeds. Stones that might do damage to the pump are caught by gravity in the catch box, from which they can be removed by removing the lid. After running the pump for several days last summer I did not find a single stone in the gravity catch box that could not have passed through the pump. Had the intake found any such stones, however, the gravity box would have caught them. It did catch some sand, and for the first time we found no sand in the ditch at the end of the discharge pipes.

Chunks of weeds or roots would quite often clog at the end of the 4-inch intake pipe, so that we had to raise it to near the surface and poke a stick into it to loosen them up. But once past the first elbow they never clogged. The centrifugal pump would eat up weeds about as nicely as it would drink clear water. We have pumped besides roots and muck, crabs without killing them and full grown bullheads without breaking their skin and clams without cracking their shells.

The effects of irrigation during a dry spell is like a much needed rain. The muck adds humus or fertility to the soil faster, I think, than it could be applied by two men with two manure spreaders and eight horses, besides applying it where a manure spreader could not be taken without doing damage, and we can pump muck without stint when there is no manure to haul.

ORCHARD DEVELOPMENT IN IDAHO

Opportunities for the Small as Well as Large Orchardist.

While on a recent visit to Idaho the editor of IRRIGATION AGE spent a few days with W. L. Hinds, President, and J. W. Craven, Vice President, of the Twin Falls-Deep Creek Orchard Company of Twin Falls.

This company was organized a year or two ago with the idea of setting out three or four thousand acres to apples, and subsequently cutting the property into five and ten acre tracts for sale to eastern investors.

It is a well known fact that in the past many companies organized to sell orchard property on the unit plan with similar conditions to those under which the Twin Falls-Deep Creek Orchard Company is operated, have in some instances misrepresented to investors and the promoters have not carried out their plans fully, hence the investment has not paid as well as would otherwise be possible.



Lateral on Twin Falls-Deep Creek Orchard Company's Property Near Hollister, Idaho.

This company, composed of W. L. Hinds, J. W. Craven and E. L. MacVicar, has gone to work systematically and as is shown in the following letter, set out 64,000 trees, with about 9 miles of shade trees for shelter and windbreaks. They have also adopted a plan which has not been followed closely by other companies, i. e., cultivating very carefully between all the rows, and not attempting to put any of the land in their orchard into crop. They have two large Hart-Parr engines with suitable cultivators to follow between the rows and cultivate the soil thoroughly up to the trees or the small lateral ditch line which extends along each row.



Another View of Deep Creek Orchard Showing Clean, Well Cultivated Ground Between the Rows.

Mr. Craven, who is the active head of the organization, informed the writer that they have already gone over the tract eight or nine times this season and expect to go over it once or twice more. It can, therefore, be seen that the land between the trees will be well cultivated, and the result should prove extremely profitable.

to not only the promoters but to those who invest later on in the smaller tracts.

The plan of the organization is to sell the tracts on time payments, and take care of the trees and the ground until they are in full bearing. By keeping up this system of continual cultivation, and with the surety of water, this should prove to be one of the best tracts in Idaho, if not in the entire west. The writer does not know of an orchard of the same size in the western country, although there may possibly be some in Oregon and Washington.

On the assumption that these trees will pay from \$2 to \$4 a box where the crop is sold ready boxed for shipment, it can be easily seen that a fairly good income may be derived from each acre.

The writer requested Mr. Craven to prepare a letter covering the main points of the project and we are producing it herewith.

We are also presenting half tones showing the orchard in its present condition, and it is our intention to produce illustrations from time to time as the property develops, showing the growth and condition of the entire tract.

Under the system of cultivation practiced by this company weeds are entirely eliminated and the land between the rows, as far as the eye can reach, is absolutely clean and well pulverized. The accompanying photographs will give some idea of the appearance of the newer part of the orchard at this time. Some of the young trees have shown a remarkable growth this year, in many instances six or seven inches.

The entire tract is fenced with woven wire 52 inches high—what is known as the "hog-tight" or "rabbit proof" type, and this is supplemented by an additional 2 feet at the base of very finely woven chicken wire. This is necessary to prevent the encroachment of jack rabbits which prove a pest where they are allowed to get into orchards or fields of wheat or other grains. As the country develops this difficulty will be removed by the natural process of killing them off or by driving them into more remote sections.

This orchard, or more properly speaking their two orchards, lie directly west of Hollister, Idaho, in what is known as the Twin Falls Salmon River section of the state, although the water right and reservoirs are entirely distinct from the Kuhn or any other interest.

It is generally believed that this will prove to be one of the best apple growing sections in the United States, as west and south of the tract may be found orchards 15 and 20 years old that have produced regularly and heavily, and this demonstrates to the promoters of the Twin Falls-Deep Creek tract that there will be no difficulty in bringing their orchard up to the bearing age without a set back.

On this tract whenever a tree is found to be diseased it is properly cared for at once, or is cut out and burned. Furthermore, if anyone is found offering for sale, fruit affected by any pest, or even wormy fruit, he is subject in Idaho, to a heavy fine.

Many people are of the opinion that there may possibly in time be an over-production of apples in Idaho, and other western states. When it is considered, however, that throughout the civilized world the apple is becoming more and more in demand, it is safe to say that our increasing population will keep the demand in advance of production.

In the east the San Jose scale, the wooly aphis, the codlin moth are killing thousands of acres of orchards every year and much of the crop that would otherwise be raised is killed by the frost.

We are presenting below the letter written by Mr. Craven, as mentioned above:

Twin Falls, Idaho, August 14, 1912.

Mr. D. H. Anderson, Editor,
Chicago, Ill.

My dear Mr. Anderson:

Referring to your recent visit here I am pleased to enclose you some of the views taken of our trip through the valley, especially those on the Deep Creek Orchards. In connection I wish to state that my holdings and those of the company, which will combine within the next year, amount to 8,205 acres. My company has planted this year 1,320 acres, all set with four varieties, only apple trees; around these orchards we have planted rows of shade trees, extending nine and one-half miles.

These orchard lands are situated in the valley of Deep Creek, three miles due west of Hollister, Idaho, and has a water right, which they purchased from the Twin Falls Deep Creek Land & Water Com-

pany. The character of this soil is a compound mixture of lava ash and what is commonly called silt loam; the latter being disposed of by overflows and coming from the foot hills. We have a soil about six feet of this character and then coming into gravel subsoil, which has a thickness of twelve to fifteen feet, about the center of which a flow of water has been tested and pronounced chemically pure. It is supposed to come from the snow drifts in the mountains of the Shoshone range; this never failing flow of water at the depth of twelve to fifteen feet is secured upon each side of this stream at a distance of three-quarters of a mile, extending through the valley. I know of no other valley in the northwest so much favored in this respect.

While this particular valley is a fruit section, it is in its infancy, its future is assured from the older orchards in the vicinity just west and the vicinity just south and east of this tract. They have never failed to bear and one of the old settlers, John Hansen of Rock



Headers and Separators at Work in Grain Field on Twin Falls Salmon River Tract. This Ground Was Covered With Sage Brush One Year Ago.

Creek, states that he has been picking apples from his orchard for twenty-eight years, also peaches, and that he never had but one failure in peaches, which was in the year 1891, and never a failure in apples.

It is the object of the Twin Falls Deep Creek Orchard Company to finish planting its entire acreage, 3,200 acres, next spring and grow them under the direct supervision of the writer with the assistance of the best horticulturist in the Pacific northwest. These orchards are now owned by prominent business men of Des Moines, Iowa, and the prominent business men of this city.

About cultivation; the policy of this company is to give the trees all the chance and to not grow anything between the rows; it is our policy only to irrigate when needed and to cultivate eternally.

We have at this time two gasoline tractors for cultivation and sixteen mule teams; the orchard has been cultivated nine times this season and will get two more rounds before the season closes for cultivation. They have been irrigated only twice.

Very truly yours,

J. W. CRAVEN.

THE ACTIVITIES OF THE FORESTRY BUREAU.

The forestry service struck congress the other day for an additional million dollars as a reserve fund to fight fires, but the item was shaved down to \$200,000 and now a great yell is raised about it. This forestry service is becoming a national nuisance and is costing the people altogether too much money for the good they get out of it. Besides this it is a menace to our liberties and will have to be set aside some day or we will see a rebellion in this country. The most notable thing about this institution is its wonderfully rapid and extensive growth. If it were to make trees grow, as the bureau itself has grown, the problem before the people would be how to prevent the forests from taking possession of all the land surface of the globe outside the frigid zones. This is clearly indicated by the struggle in which our people are now engaged to prevent the forestry bureau from taking possession of everything west of the one hundredth meridian. Already a large part of the area of the Rocky Mountain and Pacific coast states is under the bureau's dominion. The growth of this bureau illustrates what may be done in the extension of federal activity. It has been developed through the energy of Gifford Pinchot and the employment of publicity agencies surpassing in activity anything previously known in the history of this country and it is time to put a stop to all this tomfoolery. The way to do it is to cede the land to the states.—*The Denver Field and Farm.*

Send \$1.00 for 1 year's subscription to the IRRIGATION AGE and bound copy of THE PRIMER OF IRRIGATION. If you desire a copy of The Primer of Hydraulics add \$2.50 to above price.

WHY A KEROSENE TRACTOR

By RAYMOND OLNEY

At the present time the farm tractor is a mighty important factor in the progress of scientific agriculture. And almost of equal importance in this connection is the question of fuel. It is now an established fact that, generally speaking, the internal-combustion tractor is the most practicable, the most economical, and the best adapted to farm work.

The important question then is whether tractors should be built to use kerosene or gasoline. It is a prob-

way, he wants an engine that will use the cheapest fuel there is.

Today the price of kerosene ranges from 5 to 8 cents per gallon in barrel lots while gasoline sells at 12 to 13 cents with a tendency to still further increase in cost. With a large and constantly increasing demand for gasoline and a consequent over-supply of kerosene, it stands to reason that a tractor which will burn the cheaper oils successfully, is the ideal general purpose farm tractor.

In this connection it is interesting to know that the crude oils with a paraffine base contain from 8 to 12 per cent gasoline and about 50 per cent kerosene. The crude



Rumely Oil-Pull Tractor (15-30 h. p.), Pulling Two Spalding Deep Tilling Machines, 10 to 15 Inches Deep. Engine Had Sufficient Power to Haul Another Machine.



Rumely Oil-Pull Tractor (15-30 h. p.), and Rumely Separator Threshing.

oils with asphalt base contain from one to four per cent gasoline and from 30 to 40 per cent kerosene.

The Rumely Oil Pull Tractor is a real kerosene burning tractor. By this I mean, that it will burn kerosene economically at all loads and under all conditions of atmosphere and altitude. It will burn kerosene and the cheaper petroleum oils, which can be secured at the refineries at prices as low as 1½ cents per gallon.

An important advantage in favor of this kerosene burning tractor is that kerosene is more universally distributed than is gasoline. Kerosene can be had at every country store, while gasoline is on sale only at certain points.

Another very important advantage a kerosene tractor has is the much lower cost of fuel for operating it. The fact that kerosene is ½ to ⅓ cheaper than gasoline is a

lem which is the cause of much concern among traction engine manufacturers.

A few years ago the M. Rumely Company, 1781 Main street, La Porte, Indiana, solved this question by coming to the conclusion that the kerosene-burning engine was to be the farm tractor of the future. The success of their Oil Pull Tractor in the field and its ability to use successfully the cheaper kerosenes as fuel is abundant proof of this fact.

The question of fuels has been made an important one because of the conditions which exist at the present time relative to the comparative prices of kerosene and gasoline and the abundance of each.

It is not so many years ago that gasoline was a drug on the market. Today refineries are pushed to the limit to produce a sufficient amount to supply the demand. The automobile industry is responsible for this state of affairs, and the demand for gasoline is increasing at a rapid rate.

Since kerosene is much more abundant in the distillation of crude petroleum than is gasoline, and also much cheaper, a successful kerosene tractor is a mighty economical proposition.

At the present time we have available from the distillation of crude petroleum, high-priced gasoline and low-priced kerosene. Kerosene is 300 and 500 per cent more abundant in the distillation of crude oil than is gasoline. Gallon for gallon, kerosene contains about 18 per cent more heat units than does gasoline.

The farmer wants an engine that will operate at the cheapest fuel cost per acre. To put it in another



Rumely Oil-Pull Tractor (15-30 h. p.), Pulling Two Russell Traction Graders.

point worthy of much consideration. There is considerable difference in the yearly cost of operation of an Oil Pull Tractor where kerosene is used as compared to a fuel bill where gasoline is used.

Also kerosene is not nearly as dangerous as gasoline. It does not evaporate and consequently does not involve the risk of explosion that is always present wherever gasoline is used. Again, kerosene is quite uniform in quality while gasoline is subject to considerable variation.

Let us compare the cost of operating this tractor both on gasoline and kerosene. As a matter of fact it will burn gasoline equally as well as kerosene. We will assume that the first cost of the engine is \$1,700 and that cheap kerosene costs 5 cents per gallon in barrel lots and gasoline costs 12 cents. First taking gasoline as a fuel, the cost of one day's operation is determined as follows:

30 gallons gasoline at 12 cents.....	\$ 3.60
1½ gallons lubricating oil at 20 cents.....	.30
Labor—Engineer at \$3.00, helper at \$1.50.....	4.50
Board of men at 57 cents each.....	1.14
Interest on investment at 6 per cent, assuming 200 working days per year.....	.51
Depreciation at 10 per cent, assuming 200 working days per year.....	.85

Total cost of one day's work.....\$10.90

Now comparing this with kerosene as fuel the cost of one day's operation is as follows:

30 gallons kerosene at 5 cents.....	\$ 1.50
1½ gallons lubricating oil at 20 cents.....	.30
Labor—Engineer at \$3.00, helper at \$1.50.....	4.50
Board of men at 57 cents each.....	1.14
Interest on investment at 6 per cent, assuming 200 working days per year.....	.51
Depreciation at 10 per cent, assuming 200 working days per year.....	.85

Total cost of one day's work.....\$ 8.80

Assuming that the tractor is plowing and that 15



Rumely Oil-Pull Tractor (15-30 h.p.), Hauling Five Plows and Roller.

acres are plowed in one day the cost of plowing with gasoline would be 72.6 cents per acre and in the case of kerosene it would be 58.6 cents per acre. This means a difference of 14 cents per acre in favor of kerosene.

Looking at it in another way the cost of one day's operation is \$2.10 less with kerosene than it is with gasoline. The tractor will be used approximately 200 days per year. That means that when it is using kerosene the saving effected in one year is \$420.

(Continued from page 365.)

Eighteenth Congress—1910.

September 26-30.

Pueblo, Colo.

B. A. Fowler, Phoenix, Ariz.....President
R. Insinger, Spokane, Wash.....Ch. Bd. Gov.
Arthur Hooker, Spokane, Wash.....Secretary

Nineteenth Congress—1911.

December 5-9.

Chicago, Ill.

B. A. Fowler, Phoenix, Ariz.....President
R. Insinger, Spokane, Wash.....Ch. Bd. Gov.
Arthur Hooker, Spokane, Wash.....Secretary

Place and Officers Selected for the Twentieth Congress—1912.

Salt Lake City, Utah.

Francis G. Newlands, Reno, Nev.....President
R. W. Young, Salt Lake City, Utah.....Ch. Ex. Com.
Arthur Hooker, Spokane, Wash.....Secretary
Congress Address, Salt Lake City, Utah.

AN ARTISTIC NEW ROOFING.

Of recent years unusual attention has been given to the development of special material for the perfection, protection and decoration of modern building constructions, with special reference to composition roofing.

Nobody who is buying ready roofing from time to time has any business to be ignorant of the fact that there is a very large and rapidly increasing demand for roofing that has the appearance of a shingle roof, but on the other hand, one that is fire resisting, artistic and durable.

The Heppes Company of Chicago, Ill., are manufacturing an Asphalt Shingle that is 8 inches wide and 12¾ inches long, made in three colors, red, greenish gray



A House Covered by Heppes Asphalt Shingles.

and brown. The surface is natural colored chip slate. It does not fade or wear off. They are made to last as long as the house. It only takes 420 of these Flex-a-Tile Shingles to cover 100 square feet. They are easily and quickly laid, and can be applied on the old roof boards of a shingle roof. They are applied the same as wood shingles—4 inches to the weather. They are applicable to any sloping roof on which wood shingles, slate or tin can be used. They never require painting.

The Heppes Company also manufacture what is known as Flex-a-Tile Roofing in the same colors and finishes as the Flex-a-Tile Shingles, only in rolls containing 108 square feet. Flex-a-Tile roll roofing is now being specified for use as a siding as well as a roofing. The application with suitable wooden panel strips is very effective, and lowers the cost of building without sacrificing durability and wearing qualities. A Red Flex-a-Tile Shingle roof with a Green Flex-a-Tile siding and white panel strips is extremely attractive for residences of all kinds.

Both of these items ought to appeal to the home builder, and full information can be had by applying to The Heppes Company at Chicago, Ill.

Send \$1.00 for 1 year's subscription to the IRRIGATION AGE and bound copy of THE PRIMER OF IRRIGATION. If you desire a copy of THE PRIMER OF HYDRAULICS add \$2.50 to above price.

Reclamation Notes

CALIFORNIA.

It is reported that preparations for surveys on a large irrigation project in Yuba county have been made. The proposed system will cover a large area in the northern part of the county. The district to be covered lies north of the Hallwood tract and extends to the Honcut creek near the Butte county line, and includes land in district No. 10. Water for irrigation will be taken from the Yuba river.

The Yuba Irrigation Farms company, which is to subdivide 3,000 acres of land near Wheatland, has filed articles of incorporation. The capital stock is \$100,000, of which \$500 has been subscribed. Principal office of the company is located at Sacramento. Directors of the company are: Lillian Walter, Herbert Walter, H. T. Hiatt, Anita A. Lockart and Lela M. Gilmore, all of Sacramento.

The irrigation system for the irrigation of the lands of the Los Molinos Land company is nearly completed. The land to be reclaimed lies near the town of Los Molinos, in Tehama county. A greater part of the water is taken from Mill creek, near Tehama, and some is taken from Antelope creek.

The Tulare Lake Canal company of Tulare have completed an irrigation system whereby 20,000 acres of land will be reclaimed.

The Secretary of the Interior has authorized the Reclamation Service to complete the portion of the distribution system of the Yuma irrigation project which is to supply lands in the Yuma Indian Reservation on the California side of the river. The construction work is to be done by government forces or by contract. The main canal through the reservation has been completed during the past year. The total cost of the proposed work, including structures, is estimated at \$136,000.

The Sacramento Valley Sugar company will install a concrete pipe underground irrigation system on 5,000 acres of land on the east side of the Sacramento river near Hamilton City. The acreage will be planted to sugar beets.

R. T. Stone of Oakland and associates are interested in the reclamation of a large body of land lying in southern Yolo and northern Solano counties. The "Stone" project, as it is known, is to divert the waters of the Sacramento river at Elkhorn and the waters of the Yolo basin and carry the water to the land to be reclaimed by a system which will include three lifts in getting the water to the high land. At each lift there will be a reservoir and pumps with a capacity of 400 horse power. The pumps will have a 20-inch casing and one will be placed on each side of the motor, making two at each lift. In addition to the water of the Sacramento river, the company proposes to utilize Putah creek. The water rights acquired by the company, which is known as the Solano Land and Irrigation company, amount to 1,700 second feet, but only about 800 second feet will be utilized at the point of intake. The entire cost of the project, including ditches, is estimated at \$41,000,000. The company proposes to charge an annual rate of not over \$3 per acre and the water shall be delivered in one to five applications, or more if required. The cost of the water right will be \$8 to each purchaser.

COLORADO.

The Denver Suburban Farm company of Denver has purchased 27,000 acres of drained land in Manitoba, Canada, for \$675,000. The tract is about 45 miles southeast of Winnipeg. An irrigated tract of land near Denver, including 4,000 acres, was accepted by the Canadian owners as part payment.

The Romeo Irrigation district has chosen directors and it is reported that work on the project, which will furnish water to 20,000 acres of land lying near the town of Romeo, will be begun not later than October 1st of this year. The project will involve an expenditure of \$500,000. The building of a reservoir will provide sufficient acreage under irrigation to justify the installation of a beet sugar factory in Romeo.

At a meeting of the board of directors of the Hard-

scrabble Irrigation district, held at Wetmore recently, it was decided to ratify the bond issue of two years ago and an election for this purpose will be arranged for in the near future. The amount of the bond issue is \$900,000, which, it is estimated, will cover the entire expense of putting water on to the 10,000 acres of land in the district. Immediately upon the publication of the notice calling for the election, bids to complete the canals and reservoirs will be asked for and the project will be pushed to rapid completion.

IDAHO.

Frank Hanna, designing engineer on the Snake River irrigation project at Boise, has resigned from the government service and will return to Iowa, his former home. He entered the government service in 1903 and has worked on some of the largest engineering projects carried on by the government. For the past five years he has been located at Boise.

The construction and opening of the new state bridge across the Snake river will result, it is believed, in the development of the rich irrigated section known as Dead Ox flat, comprising 6,700 acres of land. The project was organized into what is known as the Payette-Oregon Slope Irrigation district, bonded for \$270,000, with a water right of \$40 an acre. The Dead Ox flat district is irrigated by pumps, and is one of the most successful in the west. Power to operate the pumps which lift the water in three lifts from the Snake river to the land is furnished by the Idaho-Oregon Light and Power company, an operating company in eastern and western Oregon.

The Secretary of the Interior has awarded contract to the Consolidated Fuel company of Salt Lake City, Utah, for furnishing approximately 5,000 tons of coal for use at the Arrowrock dam site on the Boise irrigation project. The contract price is \$2.20 per ton f. o. b. mines at Price, Utah.

The Secretary of the Interior has set apart and reserved for school purposes Block 50 in the village of Rupert, Minidoka irrigation project. The tract is situated across the street from the schoolhouse and is needed as a playground for the 400 school children of the village.

NEW MEXICO.

Thos. R. Taylor has brought in a well on his ranch 12 miles south of Deming. The well is 132 feet deep, contains 14 feet of water-bearing material and is equipped with a No. 5 American centrifugal pump, 30 h. p. Stover engine, and delivers 800 gallons of water per minute. This makes the second irrigation well that Mr. Taylor has brought in on his property.

Providing that mutually satisfactory terms can be reached with the board of trustees of the Las Vegas grant, James R. Thorpe, a Denver, Colorado, capitalist and broker, will undertake the completion of the big irrigation project on the grant north of East Las Vegas. The project which will irrigate about 18,000 acres of land is half completed. No work has been done since last December and the Camfield Development Company's contract has expired. The cost of the project when complete will be approximately \$1,000,000.

The project for the reclamation of a large tract of land lying near the city of Raton is progressing steadily. The Retailers' Association of Raton is back of the project which is being undertaken by C. E. Hartley, J. D. Waters and associates, all of Raton. A company has been organized and incorporation papers filed, showing a capital stock of \$250,000, divided into shares of \$25 each.

The Secretary of the Interior has authorized the Reclamation Service to enter into a contract with the Stephens-Adamson company of Aurora, Ill., for furnishing conveying equipment for the sand-cement grinding plant at Elephant Butte, where the Reclamation Service is building the Engle dam in connection with the Rio Grande irrigation project. The contract price is \$6,057.10.

The Traylor Engineering company of New York city has been awarded the contract for furnishing crushing and pulverizing machinery for use in connection with the construction of the Engle dam. Contract price \$18,392.72.

OREGON.

Thos. Hawthorne, of Eugene, has been appointed engineer of the Paisley irrigation project, a new Carey Act project in this state.

TEXAS.

The Fort Stockton Irrigation company of Ft. Stockton has commenced work on its project in Pecos county. The reservoir to be constructed will impound sufficient water to irrigate 25,000 acres of land.

Dr. F. S. Pearson of El Paso is planning an irrigation project to reclaim 10,000 acres of rich land lying near Del Rio. It is stated that the expenditure involved in the construction of this project is \$1,000,000. Water for irrigation purposes is to be taken from Devil's river.

Capitalized at \$1,000,000, the Consolidated Reservoir company of Grand Falls has filed its charter with the secretary of state. The concern is to establish an irrigation plant and operate in Ward, Pecos, Reeves and Crane counties. The principal office of the company is located at Grand Falls.

Emil Locke and associates of San Antonio are planning a system to irrigate 100,000 acres of land. The land to be reclaimed lies in Bexar, Kendall and Comal counties. Two dams, one across the Cibolo, and the other the dry Comal, giving a total reservoir capacity of 2,500,000,000 cubic feet, are to be constructed. Under the plans now contemplated there will be two companies, the Comal Irrigation company and Cibolo Dam and Irrigation company. It is further stated that they may finally be merged into one, as by the construction of a tunnel several miles above Cibolo dam the two reservoirs will be joined and one flood will fill both of them. The tunnel constitutes part of the project and by means of it the necessity for an apron on the Cibolo dam will be obviated.

The Mountcastle Land and Irrigation company of Pecos, Fort Worth and Chicago, Illinois, has been incorporated at Austin, Texas, with a capitalization of \$600,000. The incorporators are G. C. Mountcastle and R. I. Merrill of Fort Worth, Texas; Sol. Meyer of Denver, Colorado; E. E. Edwards, W. S. Rosenbaum, Fred Uhlman and A. R. Crane, all of Chicago, Illinois. The first work of the new company will be to perfect the present available water supply, after which they will greatly enlarge the present water supply.

The El Fresnal Irrigated Land company of San Benito, has filed articles of incorporation showing a capital stock of \$10,000.

The Medina Irrigation company of San Antonio, which was chartered to build the big dam and irrigation system now in course of construction on the Medina river, in Medina county, has filed a certificate of dissolution. The property of the concern has been taken over by the Medina Valley Irrigation company of Denver, Colorado.

WASHINGTON.

The Secretary of the Interior has announced that the property now owned by the Reclamation Service, being lots 1 and 2, block 268, Ker's Addition to North Yakima, with the buildings thereon now occupied as an office in connection with the Yakima irrigation project, will be sold at public auction on October 15, 1912. No bids will be received for less than \$5,750.

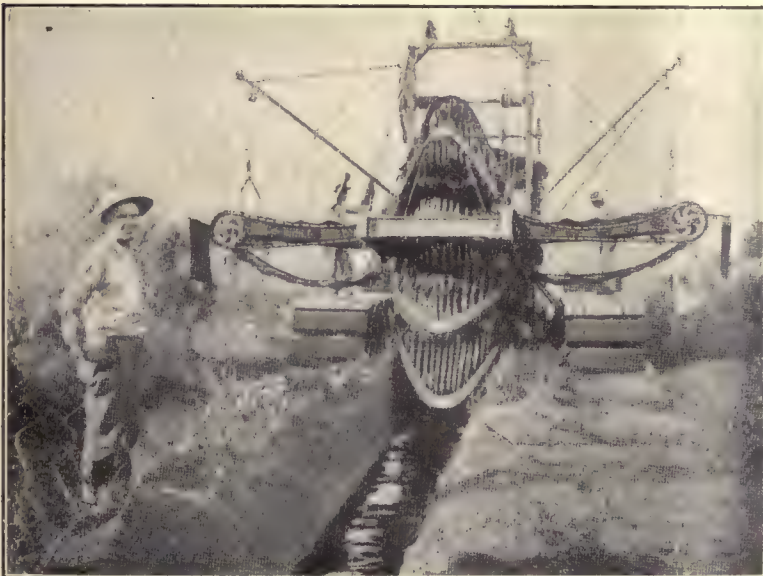
F. H. Phipps has been elected secretary of the Brewster Irrigation district, which will undertake to water 15,000 acres on the Brewster flat. Surveys have been commenced and bonds will be floated after completion of the surveys. The district has been formed under the state law. The intake will be near the town of Methow, and from there the water will be carried several miles to be used in reclaiming the arid lands.

Articles of incorporation for the Bacon Tract Irrigation company have been filed. Principal office of the company is located at Spokane; capital stock is \$20,000.

The United Orchards Development Company of Spokane propose to irrigate 634 acres of its holdings in the Moses Lake district. The tract will be watered by wells, and four pumping plants are to be installed immediately. The company has been incorporated under the state law of Washington with a fully paid-up capital of \$50,000.

L. L. Work, president of the First National Bank of Oroville is authority for the statement that extensive irrigation is planned in the Okanogan valley. The land to be reclaimed is divided into two tracts and two irrigation districts have been formed.

For Irrigation and Reclamation Work Buckeye Open Ditchers



FOR irrigation and reclamation work the Buckeye Open Ditcher has proved its efficiency and economy. The machine is built in various sizes, cutting ditches from 21½ to 12 feet wide at the top, and the ditches can be cut true to grade.

The Buckeye Open Ditcher has been in continuous use for several years under the most trying conditions in the South and West, and by its use thousands of acres of waste lands have been reclaimed and made valuable.

Write for Catalog 26—and let us tell you where Buckeye Open Ditchers are in use and what they have done.

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MINERAL WASTE.

In the preface to Bulletin 47, Notes on Mineral Waste, written by Charles L. Parsons, chief mineral chemist of the Bureau of Mines, which has just been issued, Dr. Joseph A. Holmes, the director, gives his views upon what he terms real or true conservation.

Dr. Holmes says: "During the past year, in producing 500,000,000 tons of coal we wasted or left underground, in such condition that it probably will not be recovered in the future, 250,000,000 tons of coal; we turned loose into the atmosphere a quantity of natural gas larger than the total output of artificial gas during the same period in all the towns and cities of the United States; we also wasted or lost in the mining, preparation, and treatment of other important metalliferous and non-metalliferous minerals from 10 to 15 per cent of the year's production of such minerals. These losses serve to indicate the importance of inquiries and investigations by the Federal Government for the purpose of lessening the waste of essential resources—investigations on the same general lines as those looking to a reduction in the

loss of life in the mining operations of the country and the far more extensive investigations looking to the more efficient production and use of agricultural products, both of which are being conducted by the Federal Government.

"In a consideration of the possible activities of the individual, the State, and the Federal Government, in behalf of a less wasteful use of our mineral resources, certain facts and principles should be kept clearly in mind, namely:

"That the present generation has the power, and it will exercise the right, to use as much of the country's resources as it actually needs; there can and there will be no such thing as stinting the present generation by bottling up resources for the use of the future.

"That the Nation's needs are not likely to be curtailed; these needs will increase with the extent and diversity of the Nation's industries, and they will increase more rapidly than population increases, for the reason that the per capita consumption of mineral products is rapidly increasing; and

"That the men of this generation will not mine, extract, or use these resources at continuous financial loss to themselves in order that something may be left for the use of future generations; there can be no such thing as a mineral industry without profits.

"Furthermore, it should be clearly understood that the mineral resources of this country have required long ages for their accumulation and that of these resources the Nation has but the one supply. There are no known substitutes available to meet the Nation's further needs when that supply will be exhausted and, to the best of our present knowledge, this one supply must serve as a basis for both the needs of the present and the far greater needs of the future.

"In a higher way our mineral resources should be regarded as property to be used and to be held in trust with regard to both the present and the future needs of the country. It should be remembered that neither human labor nor any human agency has contributed to their origin or to their intrinsic value, and that whatever rights the individual may possess have been derived from the General Government and from the State as the original owner. The State does not surrender its right, and should not neglect its duty, to safeguard the welfare of its future citizens by preventing the wasteful use of these resources. Though the individual may claim the right to use the resources in proportion to his needs and the needs of the community, he certainly has no right to waste that which is not needed for present use but is certain to be needed hereafter.

"Those in charge of the investigations of the Bureau of Mines recognize the rights and duties of the Federal Government as being limited to the carrying on of inquiries and investigations with a view to determining the nature and extent of this waste of resources, the means by which it may be diminished, and the setting forth of the facts in the case.

"The present report embodies the results of certain preliminary inquiries as to the nature and extent of this waste. It will be followed by a more detailed report on the subject as soon as the necessary inquiries and investigations have been conducted and the results put in shape for publication.



You don't have to undergo the mess and dirt and bother of plastering—you don't have to wait weeks for it to dry only to find it cracked and crazed in a dozen places.

UTILITY WALL BOARD

takes the place of both lath and plaster. It is put on easily and quickly—nailed direct to the studding. There is no muss—no waiting for it to dry—and once in place it is there to stay as long as the house lasts—It will not warp, or crack, or shrink—It may be decorated in any style desired—It is more economical than lath and plaster. *It is the Ideal covering for walls and ceilings.*

Utility Wall Board is peculiarly adapted to the Bungalow type of dwelling and to boat houses, garages, chicken houses and so forth.

Use it in making over the old house as well as in building the new.

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Supreme Court Decisions

Irrigation Cases

WASTE—

One is entitled to use water only in such quantities and at such times as may be reasonably necessary for some useful purpose, either existing or fairly contemplated in the future, and cannot waste water even for a useful purpose.—*Cantrall v. Sterling Mining Co.*, Supreme Court of Oregon, 122 Pacific 42.

ACTS CONSTITUTING APPROPRIATION—

A party, to acquire under the statute a right to the use of unappropriated waters for irrigation, must take, divert, and use the waters; and the making of a survey and the posting of a notice of appropriation confer no rights.—*Coray v. Holbrook*, Supreme Court of Utah, 121 Pacific 572.

ABANDONMENT—

Where an appropriator of water of a stream, pursuant to a notice of appropriation of a specified quantity, and his successors for 30 years failed to make any beneficial use of the waters, they lost any right by virtue of the appropriation and the waters became subject to appropriation by others.—*Hufford v. Dye*, Supreme Court of California, 121 Pacific 400.

ESTABLISHING PRIORITY—

Where statutes authorizing the adjudication of water rights, for purposes other than irrigation, did not become effective until after the date of a decree settling a priority in a stream for "domestic, household, stock, and other beneficial purposes," the decree is improper, as without authority.—*Doll v. McEllen*, Court of Appeals of Colorado, 121 Pacific 149.

RIGHT TO SUE—

Where a plaintiff sued to quiet title in a water right, a defendant, who, as the owner of the opposing right, had leased it to other defendants, was entitled to bring a counterclaim for a diversion of the water by the plaintiff, as such diversion might ripen into a title by adverse use, and thus injure the reversion.—*Custer Consol. Mines Co. v. City of Helena*, Supreme Court of Montana, 122 Pacific 567.

PRESCRIPTIVE RIGHT—

Where defendant granted plaintiff the right to construct and maintain a flume over his land to carry water to irrigate plaintiff's land, and plaintiff constructed a flume and maintained it for many years, the right of maintaining it must be regarded as absolute and is capable of ripening into a prescriptive title.—*Gustin v. Harting*, Supreme Court of Wyoming, 121 Pacific 522.

CLASSIFICATION OF MATERIAL—

Where plaintiff contracted to construct an irrigation ditch, the contract providing different prices for different kinds of excavation, but no one was empowered by the contract to make a final classification, and a dispute arose as to whether a portion of the excavation was properly classified, the question was one of fact, and not of law.—*Cook v. Green River Mut. Irr. Co.*, Supreme Court of Utah, 121 Pacific 970.

IRRIGATION CONTRACT—

A provision of a contract between a construction company and the state that the construction company will sell to persons filing on lands not described therein, but susceptible of irrigation, a water right or share in the irrigation canal for every acre filed upon, is a specific promise to sell water for state lands included in the irrigation project.—*State v. Twin Falls Canal Co.*, Supreme Court of Idaho, 121 Pacific 1039.

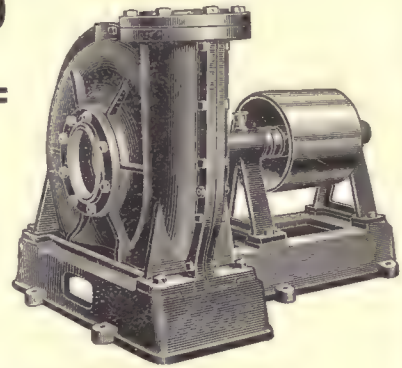
BONDS OF IRRIGATION DISTRICT—

Where an irrigation district organized under the laws of a state and expressly authorized to issue bonds, sell the same to the highest bidder after advertisement, and to use the proceeds for the construction of irrigation works, issued bonds which it had voted at par directly to a contractor in payment for work which he had performed, its action was at most no more than an irregular exercise of its power, and, where neither the district nor any taxpayer questioned the validity of the bonds until eight years after their issuance and after the right of the contractor to maintain an action at law to recover for his work was barred by limitation, a subsequent purchaser of property in the district cannot then maintain a suit to have them declared void because of such irregularity.—*Rodgers v. Thomas*, U. S. Circuit Court of Appeals, 193 Fed. 952.

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For this large
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Other sizes in
proportion.



Without
comparison the biggest
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“BUFFALO” CLASS M SIDE- SUCTION CENTRIFUGAL

For general drainage and irrigation purposes not exceeding 50 feet total head the Buffalo Class M Centrifugal Pumps represent the highest manufacturing achievement in producing, at a popular price, a pump of astonishing quality—low power consumption, smooth operation, extraordinary strength and freedom from repairs.

The large pulley is supported on either side by extra long bearings furnished with brass grease cups. The bearings are lined with genuine white babbitt metal only. To insure operation without attention, a very long packing gland is provided on the shaft. Companion flanges, both for suction and discharge opening, are furnished without extra charge. **All parts of these pumps, being accurately made, are interchangeable and can be promptly duplicated at any time.**

Our class M pumps are also furnished in vertical suction type and for submerged service. Ask for our catalog. Tight and loose pulleys, foot valves, flap valves, primers and other accessories can be furnished at a small extra cost.

The prices are f. o. b. works for iron pumps. Brass or brass fitted pumps also furnished.

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GAS ENGINE ECONOMICS.

The present stage of perfection of the gasoline engine, and the good name which it is making for itself with all those who use it are attracting a great amount of attention from a large and increasing number of the farming community. While it is not true that the gasoline engine may be

applied advantageously to all the machinery on the farm which it is possible to run with mechanical power, it is true that a large part of it which is now run by hand or horse power could be much more conveniently and economically done with gasoline engine power.

In selecting a gasoline engine there

are two important factors to be considered. First, the make of engine, and, second, the power of engine. In deciding the first factor, the average farmer does not always possess sufficient knowledge of gas engines to judge the merits of two different makes. The claims and arguments of competing manufacturers, agents and dealers are so contradictory and confusing that, unless one is an expert, his statements throw little light on the subject.

As precautionary statements in regard to the make of engine, I will say: Do not try an engine which is still in the experimental stage. Buy an engine which to your personal knowledge is giving first-class satisfaction with its users. Do not buy an engine which is exceedingly cheap. Buy an engine for which repairs can be had without sending the length of the continent for them.

In deciding upon the size of an engine one must depend entirely upon the machinery to be run. The most economical condition of gas engine operation is attained when the engine is run at full load, that is, when the machine which is driven requires the full power of the engine to drive it. This condition cannot always be obtained because it is generally the case that several machines requiring different power must be driven by the same engine. However, by using forethought in purchasing new machinery for different classes of work about the farm, the different machines can

(Continued on page 380)

Planning for the Future of Your Daughter

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"Second-foot," as defined by the United States Geological Survey, is an abbreviation for cubic foot per second and is the unit for the rate of discharge of water flowing in a stream 1 foot wide, 1 foot deep, at a rate of 1 foot per second. It is generally used as a fundamental unit in measurements of stream flow.

"Second-feet per square mile" is the average number of cubic feet of water flowing per second from each square mile of area drained, on the assumption that the

run-off is distributed uniformly both as regards time and area.

An "acre-foot" is equivalent to 43,560 cubic feet and is the quantity required to cover an acre to the depth of 1 foot. The term is commonly used in connection with storage for irrigation work.

One second-foot flow equals 7.48 United States gallons a second, 448.8 gallons a minute, or 646,317 gallons a day. As a California "miner's inch" equals 0.187 gallon a second, there are 40 California miner's inches in 1 second-foot.

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150,000 Theoretical Horse Power in Basin of Main Tributary to Colorado River.

The waters of Green River, the main branch of the Colorado, and its tributaries, while possessing large possibilities for the development of power, are practically unused except for irrigation. Theoretically it would be possible at the present time, according to the United States Geological Survey, by utilizing known storage sites, to develop about 1,500,000 horsepower in the basin of the Green. From Wells, Wyo., to the Wyoming state line, a distance of 225 miles, the stream has an average fall of 11 feet to the mile; and from the Wyoming state line to the mouth of Minnie Maude Creek, a distance of 200 miles, the average fall is 7 feet to the mile; the total fall is 3,875 feet.

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will go anywhere that a team can go and will travel two or three times as fast. It costs nothing to keep when not working. It is a steady, every-day, all-day-long worker, with power enough to meet any emergency. It is simple—any member of your family can learn to drive it. The brakes are powerful—safe on any hill. The springs are resilient, making the car easy-riding. There is an auxiliary spring to take care of heavy loads.

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MANITOBA HOMESTEAD ENTRIES.

Entries filed for homesteads in the province of Manitoba during the month of July, 1912, were 261 in number, showing an increase of 69 over the same month last year, which, in turn, exceeded 1910 in homestead entries by 22. These figures are pointed to by officials of the Dominion Land Department as indicating a steady growth in this branch of the department's activities and a growing appreciation by immigrants to Western Canada of the opportunities afforded homeseekers in Manitoba. "The class of people taking up these homesteads is all that could be desired—the best in the land," says L. Rankin, Dominion land agent at Winnipeg. "Many of them are well-to-do, practical farmers from the east, who have sold out down below, and are prepared to take advantage of an opportunity to branch out on a larger scale. Others are good, industrious foreigners, all of whom can at least read and write, and are in every other respect qualified for good citizenship."

GAS ENGINE ECONOMICS.

(Continued from page 378)

usually be selected of such capacity that the same power will be required to run each of them, and hence an engine purchased of just sufficient power to run them. Manufacturers of power driven machinery give in their catalogues the capacity of their machines and also the amount of power required to run them.

It is often the case on a large farm that it is more economical to have two engines of different power. For instance, have one engine for pumping water, turning the grindstone, driving shop tools, etc., and a larger one for grinding feed, cutting ensilage, etc.—Colorado Agricultural College.

CAUSE AND EFFECT.

As soon as it was announced by the newspapers throughout the state of Oregon that Northwest Townsite Company had given the largest bond ever filed with the Desert Land Board of that state, guaranteeing the completion of the Paisley irrigation project, a rush was made for the U. S. Land office at Lakeview, which is the nearest point at which homestead entries can be made. Nearly all of the government land adjoining the 12,000 acres segregated for this project was immediately taken up, as desert land claims, by these homesteaders, who hope to secure some of the excess water after the Northwest Townsite Company has completed the irrigation works and has supplied the quantity that will be required by settlers on the segregation.

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The government of Victoria is making ample provision for settlers and is offering most liberal inducements. Lands are sold at prices ranging from \$30 to \$100 per acre and purchaser is allowed 1½ years to pay for same. Lands are under the greatest irrigation system ever devised by any Government.

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For particulars call or write Mr. F. T. A. FRICKE, Government Representative from Victoria, care Peck-Judah Co., 687 Market St., San Francisco.

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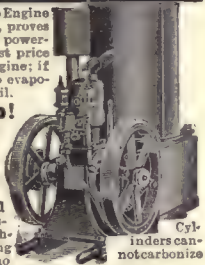
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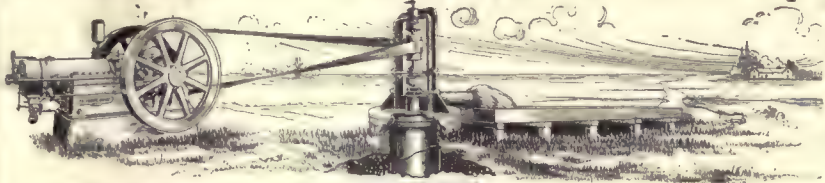
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Detroit Engine Works, 311 Bellevue Ave., Detroit, Mich.

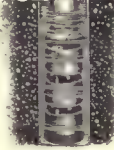


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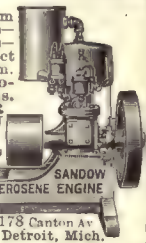
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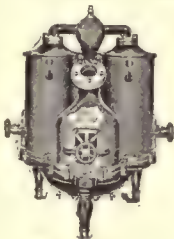
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OUT OF THE SADDLE, OUT OF THE LAND.

One proof that the opening of the Panama Canal will rapidly fill the vacant lands of the northwest with European farmers, is the fact that the foreign population of Oregon already has doubled in the past ten years, and while there is cheap land there and in Washington, yet most land in California suitable for truck gardening has advanced in price so high or is now under such intense cultivation that immigrants will pass it over and go into the interior to take up the cheaper land.

Some of the crops grown by Italian settlers near Stockton and Sacramento, California, are astonishing. These tillers of the soil, who are not afraid to get down on their knees in an onion bed, will take more money out of the northwest than will the cow men and the sheep herders, who will not get down out of the saddle to work the soil, and who are bound to disappear with the advent of the humbler but more industrious immigrant.

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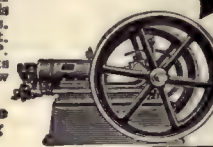
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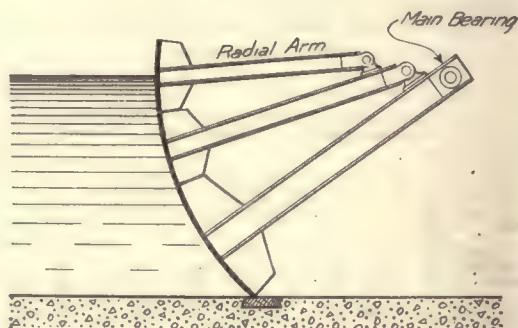


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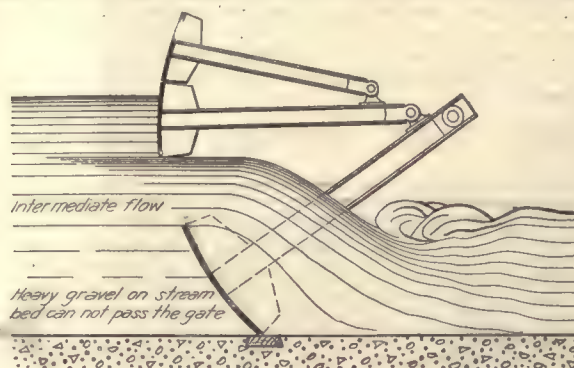
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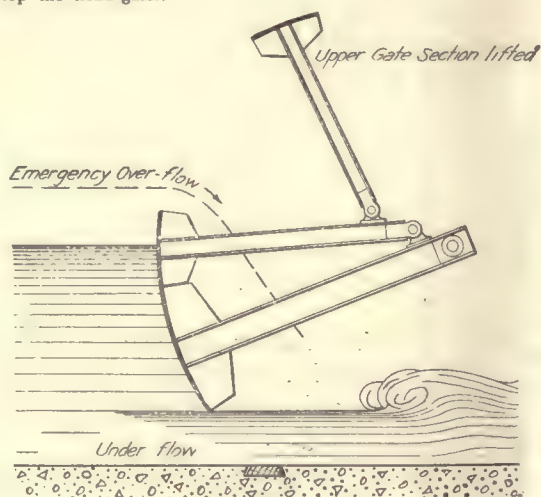


GATE RAISED FOR INTER-MEDIATE FLOW
(Head-gate example)

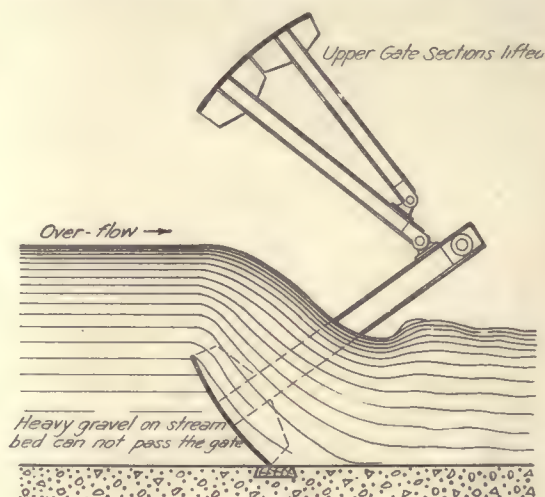
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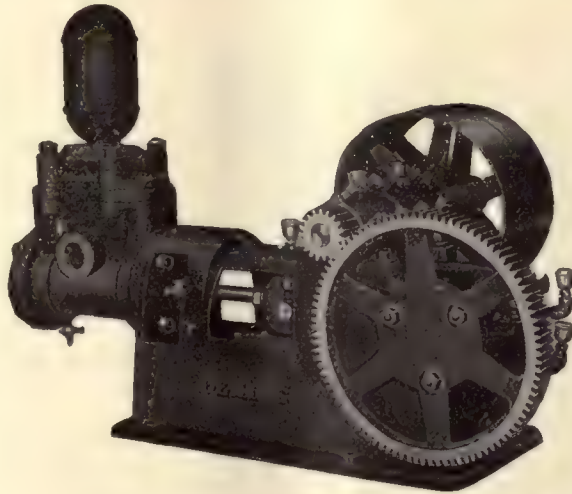
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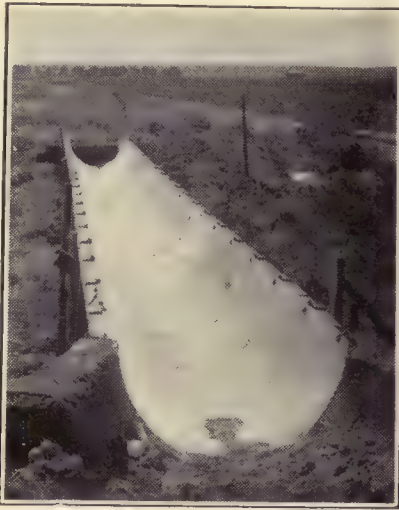
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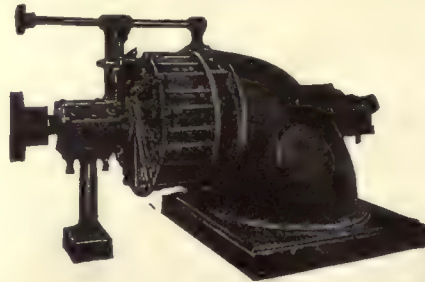
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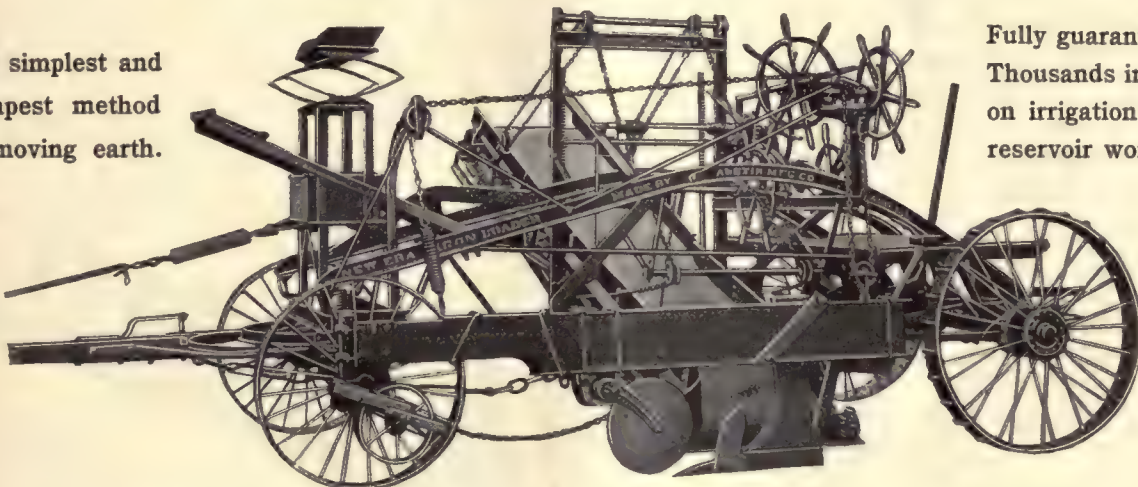
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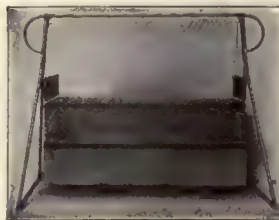


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THE IRRIGATION AGE

VOL. XXVII

CHICAGO, SEPTEMBER, 1912.

No. 11

THE IRRIGATION AGE

With which is Merged

MODERN IRRIGATION
THE IRRIGATION ERA
ARID AMERICA

THE DRAINAGE JOURNAL
MID-WEST
THE FARM HERALD

D. H. ANDERSON
PUBLISHER,

30 No. Dearborn Street, CHICAGO
Old No. 112 Dearborn St.

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D. H. ANDERSON, Editor

ANNOUNCEMENT.

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Official organ of the American Irrigation Federation.
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It may interest advertisers to know that The Irrigation Age is the
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old and is the pioneer publication of its class in the world.

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The IRRIGATION AGE has se-
cured very desirable headquarters
in the Hotel Utah, which will be
the official headquarters of the
National Irrigation Congress, and
its friends will find a representative of this publication
in room C-43 on the mezzanine floor, just one short flight
of steps above the main office floor.

All of its friends are invited to make this their
headquarters and have mail and other matter directed to
them there if they desire to do so.

Opportunity to Develop Trade in Argentina.

American manufacturers are coming in
better touch with the local agricultural
conditions of South American countries
and are supplying requests for lists and
prices of agricultural machinery for
Argentina and other countries with a
view to fill the wants of this and other growing countries.

Argentina extends across more than 2,000 miles of
latitude and is nearly one-third as large as the United
States. It may, therefore, be seen that there is a great
opportunity for development of trade in the line of imple-
ments and earth-moving machinery in that country.

The Department of Agriculture in Washington has
received information of the establishment of a division
called the Laboratory of Agricultural Mechanics and
Graphic Works in connection with the Department of
Agriculture of Argentina, with a view to study the
mechanics of utensils, motors, implements and installa-
tions relating to agriculture, their economy and use, and to

prepare graphic representations for the information of their farmers.

The director of this division has asked that the manufacturers of the United States be informed of the new office and that they may send to him detailed catalogues, with prices of agricultural machinery, motors, pumps, turbines, etc., and to report to him all data referring to new constructions and inventions.

In exchange the director will gladly give all the information possible regarding agricultural implements in use in Argentina.

Correspondence concerning this subject should be addressed to Senor Ingeniero Enrique Lopez Aldana, Laboratorio de Mecanica Agricola y Trabajos Graficos, Ministerio de Agricultura, Buenos Aires, South America.

Costly Improvements on Denver & Rio Grande System.

Announcement has recently been made by the officials of the Denver & Rio Grande Railway that it has been decided to standard gauge the present narrow gauge line over Marshall Pass between Salida and Montrose, Colorado, and this will involve the widening of the gauge from three feet to four feet eight and a half inches for a distance of 136 miles, at a cost of approximately \$2,000,000.

Between 1893 and 1900 Transcontinental trains of the Denver & Rio Grande were operated over Marshall Pass, but in the last named year a standard gauge line by way of Tennessee Pass and Glenwood Springs to Grand Junction was completed, and since then through trains have been operated over the latter route, and the Marshall Pass narrow gauge line has been reserved especially for tourists and sight-seers, and such local freight as originated in the narrow gauge territory. The Marshall Pass route has been famed the world over for its scenic attractions, as it crosses the Continental Divide at an altitude of 10,856 feet, and the new standard gauge line will cross at the same elevation and preserve many of the scenic attractions of the old route.

Marshall Pass, by reason of its being the first, is perhaps the best known crossing of the Continental Divide.

The decision of the directors to appropriate this large sum of money for the betterment of this line is an indication of the farsightedness of the officials of the road, and this move will be much appreciated by the traveling public generally.

Idaho to Become Great Dairy State.

In conversation with a gentleman who recently returned from the state of Idaho we learn that a farmer from Holland who originally located in Oregon has purchased a ranch near Buhl in the state of Idaho and has gone into the dairy business, the principal product to be high-grade cheese.

Our informant states that the Hollander is extremely enthusiastic over the possibilities of that section as a dairy country. He states that he has at present 75 milk producing cattle on his ranch and claims that he will make each head earn \$75 per year, and if they will not do that, or close to it, he would put them on the block, in other words, dispose of them.

The Hollander states further that one acre of land, planted to the right crops, in this section of Idaho will take care of one milch cow and if this is true he can make his acres earn him \$75 each per year, which would be a

very good profit on land that cost him not to exceed \$60 per acre, including a water right.

This sounds like a big story, but so many big stories have come out of Idaho which have subsequently been verified, that we are inclined to think this man knows what he is talking about. It is our intention to study this departure further when the writer visits Idaho sometime early in October and secure complete information as to this work and inform our readers from time to time concerning the development of the enterprise.

If \$75 can be made from each cow and an acre will support a cow it would be difficult to estimate the value of the land. It should certainly be worth three times its annual producing value.

Important Meeting to Be Held at Salt Lake City September 30. A conference of officials of the Reclamation Service, representatives of the Transcontinental Railways and State Land Boards will be held at Salt Lake City, Monday, September 30, 1912, just prior to the opening of the Twentieth National Irrigation Congress.

This conference will take up the subject of settlement of public lands in the west and will be attended by representatives of the railways, reclamation service and newspaper men interested in the subject.

The questions to be discussed are as follows:

- (1) How to find the name and address of the man who really desires a small farm.
- (2) How to sift out of the thousands of names thus obtained those persons who are presumably competent to make a success.
- (3) How to gain the confidence of the latter and to make valuable suggestions to them.
- (4) How to test the various agencies or individuals who are offering opportunities to determine whether the lands offered are suitable for small farms and homes.
- (5) How to get the information concerning these lands to the persons who are seeking them.
- (6) How to eliminate the agencies which are known or suspected to be untrustworthy.

These questions were gone over carefully at a series of meetings held in Chicago in May of this year, and it was decided to hold meetings at stated periods in the future so that the matter could be thoroughly threshed out.

Thousands of letters are received annually by the reclamation officials and railways and publishers of irrigation journals from home-seekers who are anxious to know where to locate and who wish descriptions of various localities.

It is almost impossible to answer these questions fully and at the same time be fair to the promoters of various projects throughout the west—hence it was decided that there should be some central organization to whom such inquiries may be referred—one which will be absolutely impartial, and which will gain the confidence of inquirers by having no indirect or concealed interest in placing the people in any particular section.

The question to be considered is as to what agencies now exist and to what extent they may be unified to be more effective and further safeguard investments of intending settlers.

This is a large problem and will, no doubt, be carefully gone over by the gentlemen who will attend the conference, a report of which will be given in a future issue of THE IRRIGATION AGE.

**Distinguished
Foreign
Visitors
Entertained.**

Chicago has had as visitors recently Sir George Reid, High Commissioner of Australia to Great Britain, and Dr. Elwood Mead, head of irrigation department of the State of Victoria, Australia.

The presence of these gentlemen has been the means of giving, through interviews in the daily papers, much information concerning the remarkable development now going on in the island continent of the southern hemisphere.

It also emphasizes the fact that Australia has become one of the most valuable of foreign customers for goods manufactured in the United States, and this is particularly true in the field of agricultural implements and earth-moving machinery.

Australia has almost an equal area to that of the United States (Alaska excepted) and great progress in irrigation work is going on under the guidance of Dr. Mead in Victoria and the various directors of irrigation in the other states of that country. South Australia, as has been stated previously in this journal, has made wonderful progress under Mr. Samuel McIntosh, director of irrigation for that state.

In the state of Victoria, where Dr. Mead has charge of this work, it is estimated that about \$11,000,000 has been expended on irrigation work so far, and this sum will be largely increased, probably to the extent eventually of nearly \$20,000,000.

While in this city Dr. Mead was in touch with manufacturers of various lines of machinery with a view of introducing some of their products in his country. This includes the manufacturers of pumps, all classes of agricultural machinery, earth-moving machinery, such as scrapers, levelers and trench digging machinery.

Investigation was also made as to the availability of corrugated metal for culvert work and metal flumes to conduct water over depressions, etc., and there is no doubt but that the visit of Dr. Mead will eventually result in the sale of large quantities of this class of machinery running into the hundreds of thousands of dollars.

When Mr. McIntosh was here in the latter part of 1911 he ordered machinery to the extent of some \$200,000, which has gone into his state, and in a recent communication from him he informs us that orders will be placed with American manufacturers for a lot more of this same class of machinery.

The bulk of this money was spent with Chicago manufacturers or the local representatives of manufacturers of outlying states, and this should teach the manufacturers that it would be worth while for them to cultivate this growing trade in Australia. The sales when made, as were those through Mr. McIntosh and other representatives of the Australian government, have been made direct to the states represented by these gentlemen, where the question of credit cuts no figure as the government stands back of all orders placed by its representatives.

It is safe to say that American manufacturers will sell several million dollars' worth of machinery in Australia within the next five years, and those who are not already established there or represented by local houses should get in touch with the government officials and place the merits of their goods before these gentlemen so that they may be considered at the time purchases are made.

The reason why large quantities of these goods are purchased in America is due to the fact that other manufacturing countries like England, Germany and France are not as familiar with conditions associated with irrigation development as are those of the United States, who are continually studying the subject with a view to supply the demand from our irrigated areas of the west. No doubt in time European manufacturers will fall in line and make a careful study of the needs of Australia and other similarly situated countries, but the fact that they have not done so up to this time leaves an open field for splendid work on the part of American manufacturers, and those who do not improve this opportunity will have regrets to register in years to come.

**To Encourage
Investment in
Irrigation
Securities.**

At a recent meeting of the Colorado Bankers' Association held in Pueblo, that body discussed the subject of an effort to rehabilitate irrigation securities, and to that end an official lecturer of the Colorado Bankers' Association was ap-

pointed to discuss throughout the country the value of irrigation securities.

In the old days when the N. W. Harris Co. and other large operators took hold of irrigation securities, heavy losses were encountered, and some of the financial houses were cautious about accepting irrigation securities during the time of the heavy movement in irrigation work from 1902 to the time of the Trowbridge-Niver failure a year or more ago.

There has never been any doubt in the minds of those who are familiar with western conditions as to the value of irrigation bonds. Wherever a project has been taken over, thoroughly investigated, with assurance of water supply and fair soil conditions, a reasonable bond issue has been considered good by conservative bankers and buyers.

The principal trouble with irrigation bonds, not only in the early California days, but in recent years as well, has been that ambitious individuals have formed companies, had segregations made of land, made filings on certain waters without going to the trouble of engaging high-grade engineers to determine the feasibility of the distribution of the water where it could be obtained, or of still more importance, a definite knowledge that water would be secured in sufficient quantity to cover the tract. It has frequently occurred that all of the matters of survey, method of distribution of the water, etc., have been fully covered and protected, when some engineering fault or poor construction resulting from a desire to hurry the project to completion has led to disastrous washouts which have not only eliminated the bond value, but have placed hardships upon hundreds of settlers who have filed in good faith on a project.

THE IRRIGATION AGE has avoided saying anything concerning these numerous failures, the idea being that by giving publicity to such institutions much harm would be done to legitimate, well-managed companies.

It would have been much better, perhaps, to have given the facts as they came to our notice, but that has been a question in the mind of the publisher.

We have, however, decided to investigate carefully various projects about which questions have arisen, and give the facts concerning their exploitation, water quantity, soil conditions, etc.

It is not our intention to cover all cases of this character, but to take up the most flagrant violators and tell the truth about them.

The Bankers' Association of Colorado has taken a proper step to place reliable irrigation properties where they may be recognized by bond buyers.

It would have been well for the Bankers' Association to appoint a committee to investigate all irrigation projects about which there is any question. This would place them in the right light before the institutions controlling the investment of money in this character of securities.

Those who have followed the irrigation movement during the past ten or twelve years are well aware that many of the large bond houses did much to weaken irrigation securities in their greed to take over all projects offered which appeared to have merit before a careful investigation was made.

There may be cited several companies which, in order to forestall action in the way of acquirement of properties by rival houses, took over projects which eventually resulted in their undoing. There was, at one time, a craze to take over everything offered so that competitors would be kept out of certain fields.

The result of all of this sort of manipulation has been to discredit bond issues on wholly reliable and substantial irrigation projects. This has hampered many of the better class of promoters who have gone out and developed a property and expended large sums of money to bring it up to a bonding basis. There are easily three or four hundred good projects lying dormant today where 33 per cent of the development work has been performed and paid for.

If the bankers and those controlling investments in irrigation securities would take the trouble to investigate a few of these projects this statement could be easily verified.

The writer has in mind a project in Wyoming where \$75,000 has been expended in preliminary work, the filings have been accepted by the state land board and all requirements of the law fully complied with, and yet this project, organized by high-grade business men who went into the matter in good faith, lies practically dead, while its bonds go begging.

This same property could easily be made worth \$1,000,000 by the expenditure of an additional \$100,000, and it is difficult to understand why bankers with large surplus of money that could be used for this purpose do not make a careful investigation and help out such worthy projects.

There is no doubt in the writer's mind that irrigation securities are coming back, and a careful investigation, as suggested, would do much to hasten this end.

It is our intention to publish in a subsequent issue of THE IRRIGATION AGE an article on this subject by one of the leading bankers of the state of Colorado who has made a study of the subject.

Send \$1.00 for 1 year's subscription to the IRRIGATION AGE and bound copy of THE PRIMER OF IRRIGATION. If you desire a copy of The Primer of Hydraulics add \$2.50 to above price.

IRRIGATION IN VICTORIA, AUSTRALIA

A Valuable Customer of American Manufacturers.

The presence in Chicago on September 12 and 13 of Sir George Reid, High Commissioner of Australia to Great Britain, and Elwood Mead, head of the irrigation department of the State of Victoria, Australia, brings into prominence the remarkable development now going on in the island continent of the southern hemisphere.

This continent is already one of the most valuable of the foreign customers of the United States, making large purchases of all kinds of machinery and ranking second only to Great Britain as a buyer of American motor cars.

Mr. Mead is an American who went to Australia five years ago, resigning the positions of Chief of Irrigation and Drainage Investigations of the U. S. Department of Agriculture, and Professor of Irrigation Institutions, University of California, to accept the position he now holds. From him, some interesting facts have been gathered regarding the progress being made in the settlement of irrigated lands of Victoria.



Dr. Elwood Mead, Head of the Irrigation Department, State of Victoria, Australia.

The state of Victoria is about the size of Colorado and has the climate of California. A dividing range crosses the state from east to west. Between the range and the sea-coast, irrigation is not required, but north of the range there is a wet winter and dry summer, the conditions being almost identical with those of the Sacramento and San Joaquin valleys in California. It is in this northern half of the state that the most important development of irrigation in Australia has taken place, and the results of this have given to Victoria the name of "The Garden State of Australia."

The first irrigation district to be established was founded by the Chaffey Brothers, who went to Victoria from near Los Angeles, Cal. The name of the cooperative settlement which they founded is Mildura. It is remarkably prosperous. Six thousand people live on twelve thousand acres of land. They grow a large part of the raisins and other dried fruits consumed in Australia and are large producers of citrus fruits. The average value of

the products for this district during the last year was about \$200 an acre. Mildura is the only important district in Victoria where the irrigation works are privately owned. All the others are state works on which the state has expended up to the present time about \$20,000,000. These state works provide water for stock and domestic purposes with limited irrigation for about 11,000,000 acres of land, of which, over 1,000,000 acres will be fully irrigated when development has been completed.

The Goulburn Scheme.

The largest of the state works is known as the Goulburn Scheme. It is designed to utilize the water of the Goulburn river, the largest river in Victoria. From a massive granite diversion weir, fifty feet high, two main canals, one on either side of the river, have been built as the main supply channels for a fertile plain about 100 miles long and 25 miles wide. In all, the scheme embraces 1,400,000 acres of land, of which, one and a quarter million acres is irrigable. The state has spent on this scheme, \$11,000,000, and expects to expend as much more before the work is finally completed. The work now completed includes the two main canals, a reservoir to hold 220,000 acre feet of water, and distributing canals to supply about 400,000 acres of land.

The most interesting feature to Americans of the Victorian irrigation scheme is the manner in which the government is settling this land, because the settlement of western irrigation districts has been, and is, the most difficult problem of the arid states of this country. The weakness of irrigation development has been that attention has been too largely concentrated on engineering and financial schemes for making water available and not enough on bringing the water into immediate and profitable use. This is now being corrected and the experience of Victoria ought to be of great value in working out here of comprehensive and successful schemes.

Victorian Land Settlement Methods.

When the state of Victoria entered on the settlement of its irrigated districts it owned no land, the public land having passed into private ownership about forty years ago. This land, like the land of the Sacramento valley, will grow crops without irrigation and had been used chiefly for wheat growing and pasture. It was held in large estates, the conditions being very similar to those existing in California twenty years ago. The state decided to make closer settlement and thorough cultivation, the corner-stone of its irrigation policy, and to do this under such conditions that men who had industry, ambition and thrift could secure a home in the irrigated areas if they had only a limited amount of money. It was also decided to plan the distributory channels and the land sub-divisions so as to give the greatest economy and efficiency in delivering and using water, the idea being to create a system that would require no changes in the future. In order to do this the state decided to re-purchase a large area of suitable land on which to create model communities which would serve as examples for private sub-divisions by land owners should these be undertaken. Up to the present the state has purchased and subdivided about 100,000 acres under the Goulburn Scheme. It has also carried out the same policy in other districts. The blocks offered settlers vary in size from two acres to two-hundred acres. The two-acre blocks are intended as homes for farm laborers. This area of irrigated land will enable a laborer to keep a cow, some pigs and poultry and to have his own fruit and vegetables, thus growing nearly everything he eats. These laborers' blocks are intended for married men. They give the right conditions of life for families, and give an interest in the district which makes a better workman and a better citizen.

The size of the farms depends on what the farmer intends to do. Twenty acres of land is ample for fruit. The alfalfa farms run up to two hundred acres. Under the Victorian law the state is required to deliver water on each farm, to sell it by measure, and charge only enough for the water delivered to make the work self-supporting. The state in this stands all the losses in distribution. It allots to each farmer, a definite volume of water, usually one acre foot of water to each acre, and the farmer pays for this allotment. If he needs more water he buys it at

the same rate. The charges for water depend on the cost of supplying it and vary in different districts from \$1.25 to \$5.00 an acre foot. The sub-divisions of land are made to fit the canals like the blocks along the city streets.

Aid to Settlers. Ready Made Farms.

Having planned for providing the water and subdividing the land the state made provision for giving needed financial assistance. It based this aid on the conditions which it saw would confront settlers who have limited capital, although some of the features are equally attractive to settlers who have plenty of money. The state realized that the settler with small capital would need his money to buy live stock, farming implements, and to make needed improvements. It would help him if he only had to make a small payment on his land. The state, therefore, only requires a cash payment of three per cent and gives thirty-one and a half years to pay the balance, with interest at four and a half per cent. To save settlers and their families the hardship of loss of time and consequent waste of capital in living expenses, the state builds houses for them. If the houses are built after the settlers arrive, tents or portable houses are provided for a small charge while houses are being built. The settler has fifteen years' time to repay the state for his house, with interest at five per cent.

In order that settlers may have food for their live stock at once, or soon after their arrival, the state will, when requested, grade and seed a portion of each farm to alfalfa. The settler is given five years' time in which to pay for this.

Loans to Settlers.

Realizing that the first two or three years on an irrigated farm are years of a large and continuous outlay in which fences have to be built, sheds and stables erected, ditches dug and the land graded for irrigation, the state helps the settler to make this improvement by giving long time loans at five per cent interest. These improvements add more to the value of the land than they cost. The state loans up to sixty per cent of this cost and hence assumes no risks of loss while it gives the settler exactly the kind of help he needs at the time when it is most valuable.

To many Americans this doubtless seems like a risky form of socialism, but the results in Victoria have fully justified the methods employed. It has cut the interest rates to farmers to less than half the rates paid by American settlers in the western states. Instead of the four and five per cent interest rates of Victoria, American farmers in the Rocky Mountain states pay from eight to twelve per cent. Sub-dividing the land by the state and carrying out schemes for settlement by the state is much cheaper than having this done by private enterprise and the settlers in Victoria get the benefit of this saving. The result is, irrigated land is much cheaper in Victoria than in California. The returns from it are about the same.

The Results of the Victorian Land Settlement Policy.

The Victorian land settlement scheme was a departure from existing methods. It has been in operation now for about three years and is no longer an experiment. The state is entirely satisfied with the results and is making larger provisions for settlers now than ever before. Its generous provisions have overcome the barrier which the distance of Australia from America and Europe imposes. The land which the state is making ready for the settlers is being taken up rapidly, and the number of settlers coming from United States and Europe is constantly growing. So great has been the increase in travel between western America and Australia that there are now seven steamships running between Australia and ports on the Pacific coast where there were only three two years ago. The time required for the ocean journey has been reduced from twenty-eight to nineteen days. The state of Victoria gives reduced rates to settlers and has established a land settlement office at 687 Market street, San Francisco, where Mr. F. T. A. Fricke, Victorian land settlement agent, has full information. This information may also be obtained from the British Consulate General, 79 East Adams street, Chicago.

In view of the large amount of capital now tied up

(Continued on page 412.)

HYDRAULIC FILL DAMS.*

Hydraulic Sluicing Process.

(Continued from July issue.)

The development of hydraulic mining has demonstrated the practicability and economy of loosening and transporting large masses of earth or gravel by the hydraulic sluicing process. This method has been adapted to the construction of large earth dams where conditions have permitted. Where materials of construction are at hand and water under natural or even artificial head is abundant, there is no method of construction which can compare in economy with the hydraulic sluicing process, or which can be handled with so small a working force. The principal disappointments in the hydraulic method have arisen from the difficulty of securing adequate drainage for the sluiced material, and from the treachery of the sluicing water.

Drainage of Hydraulic Fills.

In a hydraulic fill dam the drainage of the sluicing water is, therefore, of controlling importance. To begin with, the sluiced material should be such that it will not retain the sluicing water for an undue time. Unless the water is drained with reasonable rapidity a marked settlement

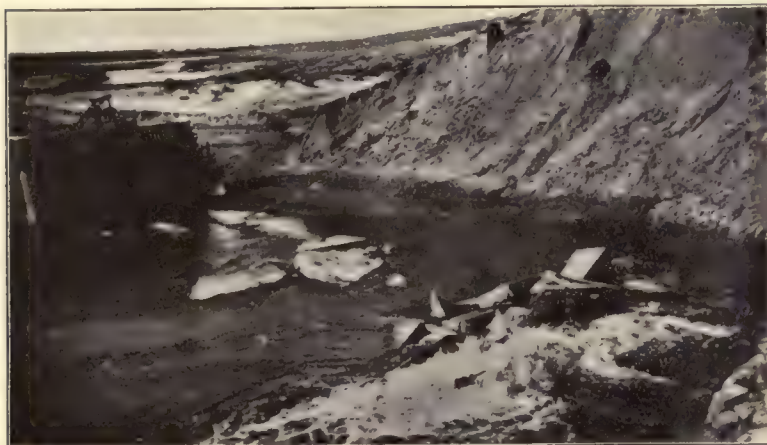


Fig. 8. Empire Reservoir Break, August 15, 1909.

with consequent cracks is bound to ensue when the fill ultimately dries out.

The sluicing water on the fill is maintained in a summit pool by hand-made levees. It is found by experience that in varying depths down to 5 feet, the material in suspension becomes comparatively solid and will then hold its shape and consistency. The sluicing water, however, must necessarily be under constant and well distributed drainage if rapid construction and solid embankments are to be realized.

A hydraulic fill dam during construction usually collects a body of water in the impounding reservoir above it, which rises substantially with the rise of the dam and but a little below its level, thereby reducing the drainage head in that direction. Assuming that there is no core wall, the sluicing water is, therefore, forced to pass largely through the down-stream fill in order to free itself unless artificial drains in some forms are provided. The passage of the drainage water through such a mass of material is slow and hence full advantage cannot be taken of this otherwise rapid method of hydraulic construction.

Again the material of the fill will not take its final set until the fill is complete and sluicing stopped. The fill is, therefore saturated during construction, and saturated material is always of greater bulk than dry material. This fact accounts in a measure for the excessive settlement in hydraulic fills.

Drainage Through a Hollow Core Wall.

The most practical method to secure controllable, well-distributed and adequate drainage in a hydraulic fill dam is by building a hollow core wall through the center of the embankment carrying it up with the work and providing it with numerous inward drainage gates of simple construction. Plate C, on page 15, illustrates this, but unfortunately the reduction of the plate is so strong as to make the drainage gates to the interior of the core wall very small and faint. Fig. 18 shows them more plainly.

It is evident at a glance that we can thereby accomplish two things:

First. We have provided an effectual water barrier, whereby when the lower prism of the dam is once drained it is forever protected against re-saturation.

Second. The problem of drainage is entirely under control and can be hastened or retarded at will. Drainage head is secured in two directions instead of one, i. e., towards the core and towards the toe. Fig. 18 illustrates this somewhat crudely by the difference in shading of the sections. The material more quickly receives its final set and unexpected settlement is thereby avoided. The time of construction is also greatly shortened.

Once the fill is completed the drainage gates into the hollow core wall from the lower prism are left permanently open, thus insuring absolute and permanent dryness of the lower prism—a result never before attained.

Materials of Construction.

The materials best adapted for hydraulic fills are those in which the percentage of clay does not exceed one-third of the total mass. Too great a burden of clay prevents adequate drainage of the sluicing waters, but a certain percentage of clay is of distinct advantage, both as to the lubrication of transported materials during the sluicing process, and as to the future impermeability of the fill. The best material is an admixture of sand, gravel, silt or clay with boulders of varying sizes. The peculiar action of "water-sorting" will classify and stratify these materials into varying grades in horizontal layers and will admit of slopes which may occasionally range as high as $1\frac{1}{2}$ to 1, although usually much flatter, depending almost wholly upon the rapidity with which the material is drained of its water.

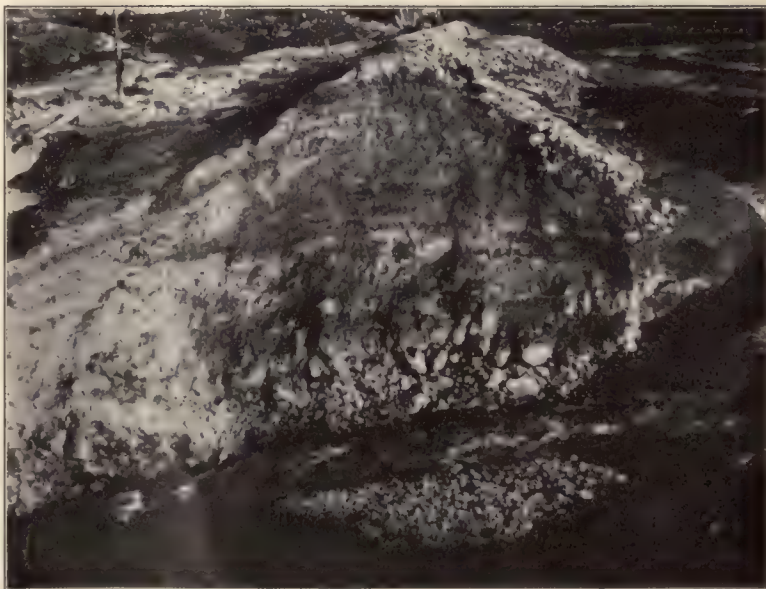


Fig. 9. Trout Lake Break, October 20, 1909.

Order of Construction.

The preferred order of construction is first to build an outlet conduit as described in connection with Fig. 15. By

*Courtesy Ambursen Hydraulic Construction Co.

thus avoiding standing water in the reservoir during construction the drainage of the sluicing water from the upper fill is greatly accelerated, due to the increased head towards the upper toe.

The next step is to begin the hollow core wall which is carried down to and sealed into the foundations underlying the dam. Sheet piling will be used below the core wall if the supporting foundation is porous. All the remarks which have heretofore been made with regard to the effect of the hollow core wall in maintaining a dry lower prism in an earth fill apply with equal force in hydraulic fill.

The hollow core wall is built up with the rise of the fill itself, being kept just above the level of the summit pond. By this means temperature cracks are avoided as the core wall is maintained by the fill at a substantially uniform temperature. No expansion joints are therefore needed.

The summit pool on the crest of the fill is retained by hand-made levees on the outer slope and by the walls of the core on the inside. The pool may be from 1 to 5 feet in depth, depending upon the rapidity with which the sluicing water drains away. It is generally found, even with sluiced material containing a high percentage of clay, that in depths exceeding 5 feet the deposited material will solidify and assume a consistency of cheese from which the suspended water will ooze and sweat until the material passes slowly through a moist and semi-plastic condition into its final set.

In practice the idea of the hydraulic fill has heretofore been to create an impervious deposit of clay within the heart of the fill, overlaid and supported on both slopes by a relatively heavy and porous fill. The first function of a supporting porous fill is to assist the drainage from the summit pool, and the second is to sustain the central body of the dam when completed. Box drains of some form have been frequently used to assist in the drainage, but these have proven uncontrollable and are a source of much annoyance. The hollow core wall, on the other hand, gives wide range and absolute certainty of control.

The placing of material by hydraulic sluicing involves what is known as "water sorting," and this results in distinct lines of approximately horizontal stratification. When there is no core wall it is necessary to break up the continuity of these various strata, otherwise they form lines of percolation through which the water from the reservoir may pass with more or less freedom, thus tending to keep the embankment in a state of constant supersaturation, even if not resulting in actual damage. To prevent this it has been customary to force boards edgewise into the soft material, and then withdrawing same to allow the sediment to fill into the voids, thus intercepting the planes of stratification.



Fig. 10. Telluride Power Co. Break, October 2, 1909.

The hollow core wall introduces altogether a different condition. Its hollow chamber absolutely insulates the lower prism from any percolation of reservoir water through the upper prism. Hence, the planes of stratification which would be a serious menace in the ordinary dam now become a distinct advantage, serving as a medium for draining both towards the outer slope and towards the core wall; see Fig. 19. So far then from attempting to prevent stratification it may, *with certain classes of material*, become an advantage to produce stratification.

Moreover, drainage from the upper prism should be facilitated by laying a course of broken stone against the outside upstream face of the core wall as shown in Fig. 19 and faintly in Plate C. This affords every facility for the drainage water to reach the various gates at various levels, and the gates themselves are controlled at will from the interior of the core wall.

The gates are of the simplest possible design, since they are to be used only during construction. They are preferably a cast iron flanged thimble set in the concrete of the wall with a covering plate in which is cast a small auxiliary thimble with its independent cover.

Another form is a smaller cast iron thimble with a coarse thread on the inside into which is lightly screwed a hard wood plug.

Incidentally, the numerous points of drainage act upon smaller bodies of material. The whole mass, therefore, much more quickly reaches its final set than is the case when the drainage of the mass as a whole cannot be completed until the sluicing is discontinued.



Fig. 12. Turkey Creek Break, July 15, 1910.

Reduction of Cost Due to Hollow Core Wall.

As in the earth fill dam the hollow core wall pays for itself in the actual first cost of construction. This arises from the fact that the rapid drainage permits of steeper slopes instead of slopes of 1 in 3 to 1 in 5, as is necessary under other methods. The rapid drainage permits of substantially the same slope as in an ordinary earth fill dam, say from 1 in $1\frac{1}{2}$ to 1 in $2\frac{1}{2}$. The reduction in the mass of material will, in most cases, offset the cost of the hollow core wall.

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DR. ELWOOD MEAD, C. E.,

Given a Magnificent Reception by the Empire Club.

Dr. Elwood Mead, C. E., chairman of the Water Supply Commission of Victoria, Australia, was given a warm reception at the British banquet given in honor of Sir George Reid, High Commissioner at London, for the Australian government. Dr. Mead spoke as follows:

America and Australia need to be better acquainted. The part they are to play in the future in shaping the commerce and civilization of the Pacific makes it to their interests and to the interests of the world that these two



Fig. 13. Riverside Reservoir Dam.

Note that the water is not the reservoir but is the seepage through the dam accumulating in the borrow pits below it. The view shows the down-stream slope of the dam.

self-governing countries should be bound together by closer ties, and that to the union of language there should come more intimate business and social relations.

It is a fortunate event for both countries, therefore, that one of the ablest statesmen of the commonwealth has been able to visit this country and interpret Australia as few other men could.

It is a great pleasure to me to be here. Ever since going to Australia, five years ago, I have realized how much these two countries could learn from each other, and how much the experience of the one will be helpful to the other in solving the different social and industrial questions created by the growth of wealth and concentration of industries.

The value of these two countries to each other arises from the fact that in their industrial ideals and political policies they have pursued a widely contrasting course.

Australia's Ideal.

In America the industrial ideal has been individual liberty and efficiency. In Australia the ideal is collective efficiency. In America the government has kept clear of all industrial enterprise or anything which savored of state socialism. It does nothing which private enterprise can be induced to carry on.

In Australia, on the contrary, the state was forced in the beginning to undertake those public utilities which the development of the country required, because the people of the country had not the capital to build railways or water works and too remote from sources of capital for private enterprise to borrow money, only the state could do this.

The success which has attended the state's incursions into industrial undertakings has led to their constant ex-

tension until now we find not only a striking contrast in conditions but an equally striking difference in the opinions of these two countries as to what is the proper limits of state action.

State-Owned Utilities.

For example: In America we find that the railways are privately owned. In Australia they are state owned. In America private companies send our telegrams. In Australia the state performs this service.

In America parcels are carried by private express companies. In Australia this is done by a state parcels post. In America public utilities like water-works, the lighting service of cities, and street railways, are, as a rule, privately owned. In Australia they are almost all publicly owned. In America mines, forests and water-powers are given away with a generous, if not prodigal hand. In Australia they are conserved, and waters and water-powers are everywhere retained in perpetual public ownership.

This list might be indefinitely extended, and if made complete today would not be so tomorrow because the sphere of state activity in Australia is constantly extending.

Nor is state ownership and the management of public utilities the most significant or important encroachment on what, in America, is considered the domain of private enterprise. The Australian states do not hesitate to undertake any industry or carry out any work which the development of the country requires. I should say in this that my experience and information is drawn wholly from the State of Victoria but it is generally true of the other states. The following illustration of the Victorian action will show in a general way the policy of all the states.

Forcing Fair Prices.

When a combination of exporters made excessive charges for the shipment of fresh meats to Europe the state of Victoria established a state cold storage warehouse; the same state is now building a much larger plant. The privately owned works still do business but they do it on reasonable terms.

When the State of Victoria found that it was compelled to pay more for coal to operate its railways than it could mine it for, it opened its own coal mines and now supplies its own fuel. In this, the state pursues the same policy adopted by American trusts, but it does it for the public good rather than for private gain. In other words, the government of Victoria regards itself authorized to do anything that will develop the State's resources or improve the conditions of the people.

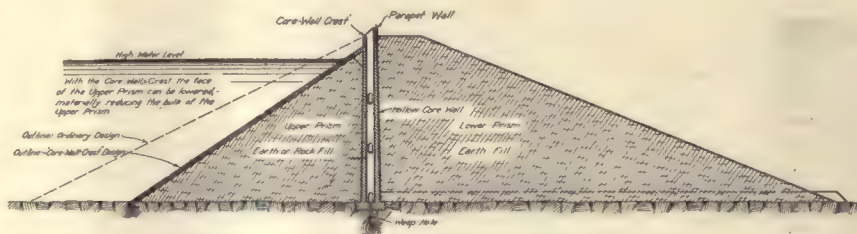


Fig. 14. Illustrating Reduction of Upper Prism.

I think you will all agree that both countries are interested in watching the results of these two contrasting policies, because the ultimate prosperity of the two countries will depend on which is the better.

When I went to Australia I was strongly prejudiced in favor of the American policy because I understood it and knew that the country had prospered under it. It seemed that state activities eventually would tend to weaken the energy, self-reliance and initiative of the people and render them less efficient. After five years I have ceased to hold that view. The Australian is not more efficient than the American but he is equally so.

Five years' experience with a state owned railway has made me a complete convert to such ownership. I have also come to believe that the state is the right agency to direct the development and conserve the use of these natural resources on which the ultimate prosperity of a country must depend. I believe that the state should do more than has been done in this country in aiding and controlling land settlement, the utilizing of minerals and the use of water-powers.

Progress in Irrigation.

One of the reasons for this is the success which has attended the efforts of the State of Victoria in directing the settlement of its irrigated land.

I lived in the arid west for twenty years before going to Australia and had seen the marvelous growth of the region. It was a wonderful exhibition of resourcefulness, courage and energy, but it was also a continuing story of hardship and privation. It seemed to me then, that this was an inevitable feature of pioneer life. I now know that this is not the case. I know this because the State of Victoria through an entirely safe and conservative use of its powers is bringing a new country into the highest state of production without any hardship to settlers and without loss of time and money. It is doing this by creating ready-made farms.

Settlers have done so well with their payments for land that the state is now contemplating reducing the interest rates on land from $4\frac{1}{2}$ to 4 per cent.

Settlers are not invited to occupy these irrigated lands

On the contrary, it is the factor on which success chiefly rests. Because of it sales of water for irrigation have increased at the rate of \$100,000 a year, each year for the last four settlers have done so well with their payments for land that the state is now contemplating reducing the interest rates on land from $4\frac{1}{2}$ to 4 per cent.

With no advantages over Western America in the way of soil, or climate, it is overcoming the barriers of distance and drawing settlers from the most fertile districts of California. Out of 45 people who came from the Pacific coast last May to Australia, 35 have either settled on the land or are selling their property in this country preparatory to doing so.

Favors State Aid.

I present this as the significant feature of Australian development which is worthy the careful attention of this country. The time is soon at hand, if the United States is to hold its population and is to continue to be an exporting nation, when farms in states like Illinois must be subdivided and opportunities created which will keep the younger generation at home. And this, in my opinion, can only be adequately done through some form of state enterprise. I am convinced that these things can be done as honestly and successfully by public authority here as in other countries.

I saw at Gary, Indiana, this week a magnificent example of private development, according to a comprehensive plan. A city of 200,000 people has been imagined and every preparation is being made for that city.

Those who are behind this enterprise are building houses for settlers exactly as the Australian states build houses and doing it better than the settlers could do it for themselves. If private enterprise can do these things in America, on so generous and complete a scale, the state can do them and that the state can do this is shown by the magnificent success made by the Federal government in building the Panama canal.

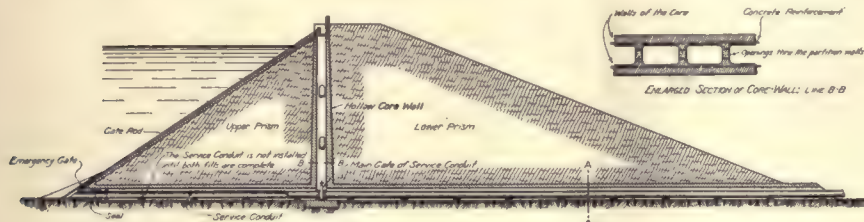


Fig. 17. Double Conduits and Service Gate in Hollow Core Wall.

until water is delivered on every farm. The state builds houses for the settlers. It plants a part of the land to a crop for the settlers. It loans them money for improvements and makes it possible for settlers coming from Europe or America to take up dairy farms and be earning a living in a new house built under their direction within 30 days after their arrival.

LARGE CROP IN YAKIMA VALLEY.

The humble prune in the role of fairy godmother is somewhat unique, but it is rewarding the faith and industry of a number of farmers in the Yakima Valley in Washington with such piles of golden shekels, as bid fair to make the section a rival to the Santa Clara Valley in California in the production of prunes. One grower in particular, when his neighbors were planting the apples and pears for which the valley is far famed, put fifty acres in prunes. He has recently shipped forty-three (43) carloads of fruit from his orchard, receiving from \$1,000 to \$1,200 per car for his shipment.

This has been a banner crop year for the Yakima project. The crop reports are not yet all in, but official reports give the shipments of Bartlett pears and peaches as the heaviest in the history of the valley. The third cutting of alfalfa is nearly completed. Heavy shipments of vegetables have been made during the entire season.

It will be some time before the returns from the big apple orchards are received, but the outlook is good for a bumper crop.

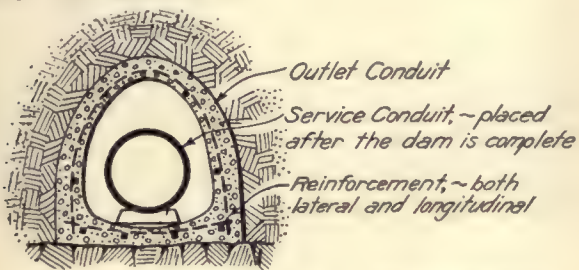


Fig. 16. SECTION A-A: SHOWING THE SERVICE CONDUIT LOCATED WITHIN THE OUTLET CONDUIT

Helping the Settler.

By giving the settler long time to pay for land it leaves him nearly all his capital for the purchase of those things needed to make the land fully productive. Through its state loans settlers get money at less than one-half the interest which settlers in the United States have to pay, and thus takes from them one of the chief burdens of pioneer life in this country.

By making comprehensive plans for the subdivision of the land, providing water and financing the settlers, it is creating a confidence and prosperity which I never saw in all my experience in this country, although I lived in some of the most successful districts. And it is doing this without any risk or loss to the public.

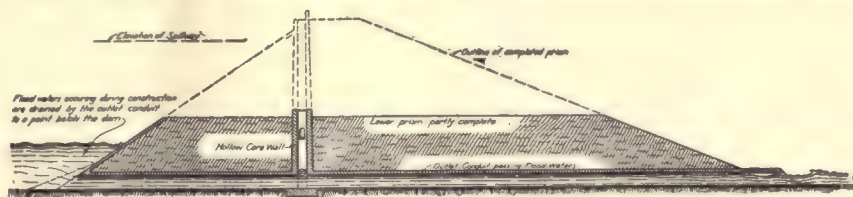


Fig. 15. Outlet Conduit Used During Construction.

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THE TRACTOR FOR DEEP TILLAGE.

By Raymond Olney.

Power is the prime requisite in the practice of deep tillage. Large teams of horses are awkward and decidedly inefficient. In order to break up the soil to a depth of 12 to 16 inches, the teams must necessarily be large and difficult to manage.

The power problem for deep tilling has been solved by the use of mechanical power. It is but a few years ago that the farm tractor was merely an experiment. Today it is a necessity in some sections of this country, and is coming to be more and more so in others. In order to practice deeper tillage, the farmers must have more available power. Where horses are used, there is a decided deficiency in this respect. The inevitable result is that the



Another View of Oil-Pull Tractor Hauling Deep Tilling Machines, Roller and Smoothing Harrows in Colorado.

farmer must turn to mechanical power as the most practical and economical to use.

The M. Rumely Company, 1771 Main street, LaPorte, Indiana, have, in their oil pull Tractor, an engine, which is especially adapted for deep tillage purposes. It is exceptionally strong and durable in construction, and is capable of withstanding the most severe service. It is now built in three different sizes which are adapted to the needs of the small as well as the large farmer.

This tractor burns the cheaper grades of kerosene, and any crude oil which does not have an asphaltic base. It is the only internal combustion tractor, at the present time, which burns the cheaper fuels economically at no load as well as full load, and under all conditions of temperature and atmosphere.

The importance of deep tillage is well known by almost every farmer. Plants feed in the soil which is turned up by the plow. The extent of this feeding ground or seed bed depends upon the amount of soil which is turned. The deeper we plow, so much larger space do we give the plant roots to work in and render more plant food available.

Deep plowing allows more moisture to enter the soil, and because it improves the capillary action in the soil, it holds the moisture better, and thus makes it available for the plants. The crops do not suffer as much from hot winds as in the case of shallow plowing.

The illustrations show this tractor hauling deep tilling machines. These machines, at a single operation, plow, pulverize and thoroughly mix the top and bottom soils together, and make it possible for the farmer to plow to a much greater depth than he usually does. It results in preparing a perfect seed bed which will conserve the moisture, improve the physical condition of the soil, increase crop yields, and consequently increase the labor returns of the farmer.

These machines, however, require a great deal of power. If this power is to be furnished by horses, it means large teams, which are, at the best, very inefficient and uneconomical. Horses are slow, and if they are used for this purpose the work must naturally extend over a

considerable length of time. It is possible to plow deep with horses, but most farmers find it impractical.

The tractor has the advantage of having a large power capacity and endurance. It will not only do the work faster, but it will also do it better. It travels at a higher rate of speed than horses, which insures better pulverization, and a more thorough mixing of the top and bottom soils. It will work longer hours per day and never becomes tired out.

This tractor has the further advantage of being less expensive than horsepower. It will usually average about 1,000 hours of work per year. During this time, the 15-horsepower oil pull Tractor, capable of replacing 15 horses for continuous work day after day, would use about 3,000 gallons of kerosene. This can be obtained at from 5 to 7 cents per gallon. At the latter figure, the fuel cost would be \$210 per year. This, together with lubricating oil, minor repairs, etc., ought not to exceed \$300 per year.

An Indiana farmer has estimated that a team of two horses requires 4 tons of hay, and about 131 bushels of corn in one year. At the present price of \$22 per ton for hay, and 65 cents per bushel for corn, the feed cost per year will be \$173. The cost of feeding 4 horses would then be \$346.

Therefore, the tractor, which has a power capacity equivalent to 15 average horses pulling on the same load day after day, has a fuel cost less than the feed cost for four horses. Even if the price of feed is cut in two, the tractor will still have a fuel expense less than the feed for half the number of horses that equal it in power.

If properly taken care of, the repair expense of this tractor will be comparatively small. A farmer, who takes care of his tractor as well as he does his horses, will find this true.

According to government statistics, an average of 27 minutes per day is spent in caring for one horse the year round. For four horses, this would amount to 657 hours per year. The tractor working 1,000 hours per year, can



Oil-Pull Tractor, Type "B," Hauling Deep Tilling Machine, Roller and Smoothing Harrows in Colorado.

be kept in first-class operating condition, including repairs and all, on much less time than this.

The amount of labor required to operate a traction outfit is no small item of consideration. One man operating the 15-horsepower tractor is able to do the work formerly done by 3 to 5 men where horses are used. At the present time, when farm help is very hard to get, the labor-saving feature of the tractor will appeal to any farmer. Every year the problem of labor becomes more difficult, and for this reason many farmers are turning their attention to the tractor and other labor-saving machinery to overcome this difficulty.

Send \$1.00 for 1 year's subscription to the IRRIGATION AGE and bound copy of THE PRIMER OF IRRIGATION. If you desire a copy of The Primer of Hydraulics add \$2.50 to above price.

BAYFIELD, COLORADO.

(Special Correspondence.)

This village of 400 industrious and prosperous inhabitants is the metropolis of the Pine River Valley, one of the most productive in the whole San Juan basin. The town itself does not make any great pretensions as a city, yet there are numerous substantial business houses and fine homes. It is the business center of a large acreage of fine irrigated farms, located on the banks of the beautiful Pine river, ten miles north of Ignacio, the nearest railroad station.

It is to the great possibilities of this section in agriculture, horticulture and stock growing that we desire to attract attention. The Pine river has its watershed high

land between the two streams on either side, and the number of acres of land, as good as there is anywhere, exceeds 200,000. For the irrigation of this vast body no provision has yet been made.

Our soil is the sandy red loam, covered with sagebrush, in places as high as a horse. There is a good sprinkling of cedar and pinon timber, supplying posts and fuel.

The elevation of the valley varies between 6,000 and 7,000 feet, just right at the altitude for the growing of the different kinds of grains and grasses—timothy, alfalfa, potatoes, vegetables and the hardier fruits. Wheat produces as high as 50 and 60 bushels to the acre, and oats up to 100 bushels. Two and three crops of alfalfa grow



C. HARDER'S HOME AND FIVE-ACRE FARM NEAR TWIN FALLS, IDAHO.
Wonderful Success Attends the Growing of Small Fruits as Well as Tree Products in the Twin Falls Country.

up in the mountains, where snow is everlasting, thus assuring a large flow of pure mountain water throughout the summer season. It is one of the biggest feeders of the San Juan river, and eventually of the Colorado river.

About twenty miles above Bayfield the valley begins and as we come down stream the valley gradually widens until Ignacio is reached, where it might be said to extend to the Piedra river on the east and the Florida river on the west.

While irrigation here is still in its primitive age, yet water from the Pine is now carried over the divide on the east through the Pine river canal and over the divide on the west through the King-Consolidated ditch. But these canals water only a small portion of the irrigable land in this section. Several other canals are now being promoted, and which it is hoped will be constructed in the near future.

With a system of reservoirs constructed, the Pine river can furnish irrigation water for all the available

land in one season, and the yield is enormous. Timothy grows to the height of six or seven feet.

We can grow the very best of potatoes in this valley, and they beat anything in this state as to quality and size.

Only a half dozen years ago the planting of fruit trees was begun in this valley, and the experiment is most gratifying. The young apple trees, four and five years old, were last year loaded down with large, glossy red apples, as fine looking specimens as can be grown anywhere. Now every farmer is planting fruit trees this season.

Just now the building of a sugar beet factory is being promoted, to be built at Durango. This valley has the proper soil for the growing of sugar beets, and once a factory at Durango it will not be long until there will be several on Pine river.

(Continued on page 408.)

CORRESPONDENCE

THE IRRIGATION AGE,
Dear Sirs:

Chicago, Ill., Sept. 10, 1912.

On April 23, 1912, the government issued to me letters patent for improvements on a certain hydraulic device for developing power from rapid currents. The wheel is mounted on two floats as far apart respectively as the width of the wheel. They are decked over, as shown in the accompanying cut, and anchored by steel cables to the banks on either side. The floats are made in sections and then sunk to the bottom of the river.

To illustrate: Suppose the river is one hundred feet wide, three feet deep and running at a velocity of six hundred feet per minute; put three wheels abreast, each eleven feet wide, the floats occupying the balance of the width of the river, thereby covering two-thirds and the wheels one-third of the width. Thus the water is forced to run through the wheel space three times faster than before. In order to get this velocity the water is dammed by the sunken floats until it has acquired a head of three feet and this volume of water falling three feet is equivalent to 1,022 horsepower. This is the theoretical result.



Dougine Water Wheel in Commission.

In an undershot wheel the practical power is rated at fifty per cent of the theoretical. If such a river had a gradual fall of eighteen feet to the mile six sets of wheels could be placed in tandem, producing in all 3,000 horsepower.

Theoretically, 3,000 horsepower would pump one foot deep of water on 272 acres every day, while practically it would pump about seventy-five per cent of the above or 200 acres per day, the water being elevated 200 feet high.

This amount of water would put three feet deep on 24,000 acres each year. Assuming that from evaporation, loss of time by all and every cause combined, that seventy-five per cent of this was lost, we would have 6,000 acres under cultivation.

In western Arizona, on the banks of the Colorado river, there are several places where patches of land amounting to more than 20,000 acres can be put under irrigation. Take a patch of 6,000 acres, yielding



Dougine Water Wheel Out of Commission.

eight tons of alfalfa per acre, worth in the field this year \$12 per ton—every year it is worth \$9 or \$72 per acre—6,000 acres worth \$432,000 for one year's crop. This land, with water, is worth from \$100 to \$500 per acre.

It is stated by our government officials that there is more than 100,000,000 horsepower in the rapid currents running wild to the sea. This does not include known waterfalls of which there are nearly 100,000,000 more, and less than 6,000,000 are now in use.

When we realize that many of these rapid currents run through our western states, most of them with banks from fifty to 1,000 feet high, while often on either bank are large quantities of the best of land only needing the water that is emptying into the sea.

Take the Colorado river as it runs along the north and west boundary line of the state of Arizona, and you have power enough in 125 miles of its north end to pump the river dry before it would reach Parker, enough to irrigate 1,000,000 acres and pump the water 200 feet high, and then have enough left to light, heat and cook for the farmer, and of far more importance, plow his land and reap his crops and take his product to market.

This is an opportunity to produce food for unborn millions and acquire fame and fortune in the immediate future.

The accompanying cuts show wheel in and out of commission. The method by which this is accomplished constitutes the merit of the patent which is an open box, an incline plain, a rack and pinion, a lever to operate same, the pinion being on each end of the wheel shaft. When in motion the racks are thrown into the pinions and in an instant the pinions pull the wheel out of gear and roll up the incline until the lower edge of the bucket is at top of water. To return the wheel into commission the upper rack is engaged with the pinion and the lower rack is withdrawn and the wheel returns into commission by the current. A fifty-ton wheel can be put in and out of commission in thirty seconds.

The device for automatically putting the wheels out of commission in case of drift-wood or any flotsam that might be in the river, work perfectly. Also a device for putting one float out of commission by dropping down stream and swinging behind its neighboring float—this is to be used in case of an avalanche of floating material.

I want to organize a company to be incorporated as the International Rivers Power Company. I will put sixty per cent in the treasury for development of the above. I want ten men with \$5,000 each—each man to be a director—I to make the eleventh director. Capital shall be \$1,000,000 divided into 1,000,000 shares, at \$1.00 per share. The ten men should receive 25,000 shares each, thus coming in on twenty cents on the dollar. When the first \$50,000 is expended the board of directors shall have the right to offer for sale 100,000 shares for fifty cents on the dollar. This would leave 250,000 shares in the treasury.

The \$100,000 acquired by the sale of 350,000 shares, judiciously expended, will erect a plant that will put water on 24,000 acres of land each year. This land will produce eight tons of alfalfa per acre each year, worth \$8 per ton in the field. The land will be worth \$150 per acre. Large as these figures appear, they are quite true. Alfalfa this year was worth \$12 per ton in the field.

This company will own the patents now issued in the Dominion of Canada and in the Republic of Mexico and also in all other countries where patents may be granted.—J. T. Dougine, 3143 West Polk street, Chicago, Ill.

South Australia.

Department of Irrigation and Reclamation.

Adelaide, August 8, 1912.

Mr. D. H. Anderson,
Chicago, U. S. A.

Dear Sir:

I am writing you to ascertain whether you can put me in touch with any reliable makers of concrete pipe, and pipe line machinery manufacturers. This is a line that we are just awakening to in Australia, and I am anxious to secure all available information of a reliable nature, with a view to business.

You will be pleased to know that the large Austin type "A" excavator is giving a most satisfactory account of itself, and has reduced the cost of shifting soil from thirty-six to six cents per cubic yard; in some instances, the same work under existing labor conditions would cost at least forty-eight cents per yard, while on the other hand the machine has taken out a considerable quantity of material at a trifle less than five cents per cubic yard. The department is also using an Austin ditcher and three municipal engineering cube concrete mixers, all of which are causing a very substantial reduction in working costs. I am expecting a new Austin type "R" excavator, and a "Marion" steam shovel to arrive during the current month. Another type "R" machine, is also expected to hand for our engineer-in-chief's department. In addition to this a number of other machines have either been ordered, or orders are closing for same, so that you will gather from this that Chicago has scored some through my visit to the States.

I have just ordered, through Cole's Booking Agency, three of your "Primer of Hydraulics," and have suggested that they might also keep a stock on hand for likely enquirers.

With kindest regards and very best wishes, I remain,

Very sincerely yours,

S. MCINTOSH, Director.

Maple, Texas,

IRRIGATION AGE.

Gentlemen: When I subscribed for your paper I thought I would find something to fit my case but up to this time I have not found the information I am seeking. Won't you please tell me how?

I live in northeast Texas and while it rains a great lot in this country the rain mostly comes when it is not needed and we have many long and severe droughts when we wish to grow crops.

Now I have about 5 acres of land on the bank of a river. The land slopes from the river bank just enough for the water to run very slowly down the rows. It is stiff, black, rich land.

The water in time of drought is about 50 feet from top of bank. I thought if I had a pump and engine on wheels I could set it at water's edge and wet the crop and then take the engine back to the house before a rise could come in the river and carry away my pump.

Won't you please tell me what kind of a pump and power to get. Also what kind of crops succeed best under irrigation. Would a steam or gasoline engine be best?

Please give me all the information you can.

Very respectfully,

W. R. HARKEY,

[Editor's Note—This letter has been referred to manufacturers who will give Mr. Harkey all the information he desires. We concluded that it was better to let the manufacturers secure the exact data, lift, etc., and thereby give him definite information.]

IRRIGATION AGE,
Chicago.

Gentlemen:

I own half of 1,200 acres of fine land on Santa Fe, near La Marr, Colo.; want to cut up and sell. Can you get me agents or some one to help sell or handle it?

E. G. KINDRED.

(Continued on page 408.)

Supreme Court Decisions Irrigation Cases

"RIGHTS AND FRANCHISES."

In Rev. Codes, § 1615, providing that a proposal to construct irrigation works shall state the price at which perpetual water rights will be sold to the settlers, such rights to embrace a proportionate interest in the canal or other water-works together with the rights and franchises attached thereto, the term "rights and franchises" means water rights as well as all other rights, including dams, canals, ditches, laterals, etc. *State v. Twin Falls Canal Co.* Supreme Court of Idaho. 121 Pacific 1039.

INTEREST IN IRRIGATION WORKS.

Rev. Codes, § 1615, providing that a proposal to construct irrigation works shall state the terms on which per-



Artesian Well, L. A. Norland's Ranch, La Jara, Colorado.

petual water rights will be sold, such rights to embrace a proportionate interest in the canal or other irrigation works, contemplates that each owner of a water right has a proportionate interest in the entire irrigation works. *State v. Twin Falls Canal Co.* Supreme Court of Idaho. 121 Pacific 1039.

PRIORITIES.

One who purchases a water right from a canal or ditch company that has made its appropriation for the purpose of sale, rental, or distribution thereof, acquires no priority until he complies with the provisions of section 5, art. 15, of the Constitution, and settles upon or improves the land with a view of receiving water for agricultural purposes, and when he does so settle upon land or improve it with diligence and good faith, he is entitled to have his priority date from the time of making such settlement or beginning such improvement. *Mellen v. Great Western Beet Sugar Co.* Supreme Court of Idaho. 122 Pacific 30.

APPROPRIATION.

One who actually settles upon or improves land lying under a canal or irrigation ditch with a view to receiving water therefrom for agricultural purposes is entitled to a priority over one who has previously purchased a water right from such canal company, but who has failed to either settle upon or improve the land as required by the provisions of section 5, art. 15, of the Constitution. *Mellen v. Great Western Beet Sugar Co.* Supreme Court of Idaho. 122 Pacific 30.

ALTERNATE USE.

Water may be used alternately by persons entitled to given quantities of the waters of a stream by virtue of a reservation in a grant of water rights. *Cantrall v. Sterling Mining Co.* Supreme Court of Oregon. 122 Pacific 42.

DAMAGES FOR FAILURE TO SUPPLY WATER.

The measure of damages for the destruction of apple trees for want of water, which have been planted and in a condition to grow, is what such destroyed trees were worth on the premises in their growing state at the time of the destruction, and in determining that question there may be taken into consideration the difference in the value of the land immediately before the trees were planted, and the value of the land after the trees were planted, which increased value results wholly by reason of the planting of the trees in a growing condition, and not an increase in the value of the land occasioned by anything else. *Hanes v. Idaho Irr. Co., Limited.* Supreme Court of Idaho. 122 Pacific 859.

IRRIGATION CONTRACT.

That provision of the state contract which authorizes the irrigation company to charge and assess the purchasers of water rights in said system not to exceed 35 cents per acre per season for each acre of land for which a water right has been purchased for maintenance purposes does not require the purchaser of a water right to pay such maintenance fee or charge until the same has been fixed by the company. *Hanes v. Idaho Irr. Co., Limited.* Supreme Court of Idaho. 122 Pacific 859.

RIPARIAN RIGHTS.

Rem. & Bal. Code, § 6327, which provides that any person owning lands, who is not the riparian proprietor, or who, being such, has not sufficient frontage to attain a sufficient flow of water to irrigate his lands, shall be entitled to a right of way to lands lying between his own and the stream, or above and below it, does not give a right to take water already appropriated, or take away the rights of a superior riparian owner. *Miller v. Baker.* Supreme Court of Washington. 122 Pacific 604.

EXCAVATION CONTRACT.

Where a contract for excavating an irrigation ditch provided different prices for different kinds of excavation, and for payment of 90 per cent of the contract price on monthly estimates of an engineer, plaintiff, by accepting such monthly installments, was not bound by the engineer's classification. *Cook v. Green River Mut. Irr. Co.* Supreme Court of Utah. 121 Pacific 970.

BRIDGING WORK.

Laws 1883, p. 261, § 38, as amended by Laws 1885, p. 324, provides that persons owning or constructing a ditch across any highway shall keep the highway open for safe travel by constructing bridges over such ditch, to be therefore maintained by the county, and that all bridges which shall be of greater length than 20 feet shall be constructed and maintained by the owners of the ditch. *Held*, that by the "construction" of a ditch provided for in the statute is meant not only the original construction, but also any enlargement, and where the necessity for the building of a bridge in excess of 20 feet was created by the enlargement of a canal after the passage of the statute, the canal company was liable for its construction and maintenance, even though the ditch was first built before the passage of the statute and the road crossing it was built after the original construction. *People v. Farmers' High Line Canal & Reservoir Co.* Supreme Court of Colorado. 123 Pacific 645.

Send \$1.00 for 1 year's subscription to the IRRIGATION AGE and bound copy of THE PRIMER OF IRRIGATION. If you desire a copy of THE PRIMER OF HYDRAULICS add \$2.50 to above price.

Reclamation Notes

CALIFORNIA.

The Yolo Water and Power Company of Woodland has purchased land in Lake county that will be covered with water when the surface of Clear creek is raised eight feet by control works at the head of Cache creek. On the completion of the irrigation system, a chain of power plants will be built along Cache creek at a cost of \$16,000,000. The surveyors have found that the fall of Cache creek is sufficient to develop great electrical power before the water is used for irrigation. The approximate cost of the project when complete is \$2,000,000.

The board of directors of the Turlock irrigation district have completed the estimate for maintenance for the year 1913 and fix the amount at \$130,000. At a recent meeting it was decided to hold a special election to vote a tax levy upon the members for the amount.

A complaint has been filed with the Railway Commission by the Merced Colony Improvement Club, of Merced, vs. The Crocker-Nuffman Land and Water Company. The complainant is an organization composed of farmers and land owners in Merced county who are served by the water system of the Crocker-Nuffman Company. They charge that the water company is failing to supply sufficient water for irrigation during the summer, that the ditches are inadequate, that the method of distribution is faulty, that the company refuses to maintain the ditches, and that the company has collected royalties without furnishing water for the full season. The complainant asks that suitable storage reservoirs be erected, that the ditches and canals be improved, that the distribution be handled systematically, that the amount of land to be furnished with water be limited to the supply during the dry season, and that the royalties be in proportion to the water supplied.

Benjamin F. Graham of Los Angeles has purchased 72,000 acres of land lying about twenty miles west of Fresno and will subdivide the ranch into small farms. Mr. Graham has organized the Graham Farm Lands Company and the company was incorporated in Los Angeles recently for \$3,000,000, the exact amount which Mr. Graham paid for the property acquired. The land lies in the center of what is declared to be one of the most pronounced artesian basins known to exist. The average depth of the wells is 600 feet and some of them have been flowing from two to eight-inch casing at the rate of from 25 to 75 inches for twenty-five years. The flow can be trebled by the use of pumps. The water development planned includes the sinking of many more artesian wells and the construction of a network of canals supplied by the San Joaquin and King rivers. The San Joaquin canal will extend entirely through the ranch and will be dug to a sufficient depth to strike the surface water, which can be utilized during the season when the river's flow is at its lowest.

A company known as the Mandeville Land Company, recently organized in Los Angeles, has purchased 7,200 acres of land lying along the San Joaquin river in the vicinity of Stockton. The company will proceed at once to perfect the reclamation of the property and expect to have it under cultivation by January 1, 1915. The purchase price of the land approximated \$400,000, and an expenditure of \$400,000 additional will be required to bring the land under cultivation.

Eastern capital is interested in a 35,000-acre reclamation project in Sutter basin between the Feather river and the by-pass planned by the Federal government. Granville Moore, of New York, and Rufus Taylor, a San Francisco attorney, are interested in the undertaking.

It is reported that the syndicate of New York, London and San Francisco capitalists that holds options

on 15,000 acres of land near Newville, will ask for deeds to the property within the next week or ten days. The options terminate October 1st. The syndicate was organized to build a large reservoir at Newville to store water for irrigation. It was planned to irrigate a large area in Tehama, Glenn and Colusa counties.

The Turlock Garden Land Company, of Turlock, has petitioned the supervisors for the formation of a reclamation district to reclaim approximately 5,000 acres of overflow land lying east of the San Joaquin river, about twelve miles southwest of Modeato. The supervisors will consider the petition October 14th.

Dr. D. A. Beattie, of San Jose, has purchased 600 acres of land near Porterville for \$60,000, which was paid in cash. Dr. Beattie already owns 160 acres adjoining the land just purchased by him, and the whole plot of land will be placed under irrigation and planted to oranges.

COLORADO.

Preliminary work on the long-discussed Taylor Park reclamation project has begun. The Taylor Park dam will, it is stated, be the largest in size and scope of any irrigation reservoir previously constructed by the United States government. The water to be impounded will be used for irrigating the arid lands of western Colorado, southern Utah and Arizona. The total cost of the dam is estimated at \$4,000,000 and the engineers assert that it will be at least four years before the masonry and concrete work is completed and water is turned into the immense basin. The site of the proposed dam is in Taylor canyon, located northeast of Almont on Taylor river.

The state land board will investigate two irrigation projects in Routt county in the near future for the purpose of determining in what manner they may help the irrigation companies. The two projects known as the Given and Leach projects, planning to water 40,000 and 50,000 acres respectively, include the watering of 20,000 acres of school land.

Work on the Hughes irrigation project, which will reclaim 80,000 acres of land lying in Moffatt county, will be begun within the next month.

NEW MEXICO.

A conditional proposition has been made to the promoters of the Pajarita Irrigation Company of Tucumcari to buy their holdings and erect a dam. The proposition was made through Commissioner Smith of the immigration department of the Rock Island railroad. The conditions of the proposition demand that at least 12,500 acres of land be secured for the promoters before the deal can be consummated.

Prof. C. A. Goggin, of Morenci, Arizona, has purchased land four miles from Albuquerque which he contemplates irrigating by means of pumps.

It is reported that Prof. J. D. Tinsley, agricultural demonstrator for the Santa Fe railroad, and State Engineer French have inspected the proposed Alamo-Urton irrigation project which is expected to irrigate 150,000 acres of land in the Pecos valley. Capitalists from Colorado Springs, Colo., are considering financing the project if the reports of the above named gentlemen are satisfactory.

A certificate of voluntary dissolution has been filed by the Irrigation Construction Company of Roswell.

L. N. Jones, of Alamogordo, is installing a sub-irrigation system on his ranch near that city. Mr. Jones is a successful truck grower and is the first man to install a sub-irrigation system in that vicinity.

OREGON.

The McKenzie Valley Irrigation Company, of Portland, has filed articles of incorporation with the Secretary of State. Capital stock is placed at \$100,000.

Filings for the appropriation of water in eastern Oregon for irrigation purposes by the Horsey Irrigation Company were completed recently, when the company filed its maps with the state engineer. The company intends to irrigate 20,000 acres of land.

State Engineer Lewis has approved the permit of Benton Bowers for the appropriation of water from Big Butte creek in the Rogue river valley for the irrigation of 8,200 acres of land.

Announcement has been made by the reclamation service that water for irrigation will be turned into the main canal at Klamath Falls not later than May 1, 1913. There has been some difference of opinion as to the time that water should be available for irrigation. Some of the farmers were of the opinion that water should be furnished not later than April 15, while others fixed the date at May 15. The matter was then taken up at a meeting of the directors of the Water Users' Association and Supervising Engineer Hopson and Project Engineer Patch of the reclamation service, who decided on the compromise date of May 1.

The recommendation of Engineer Hellerman, who visited the Klamath Indian Reservation to study the question of irrigation there, has carried through an appropriation of \$50,000 to complete the work which was begun several years ago and never completed. This will bring under water about 9,000 acres of level land in the southern part of the reservation about twenty miles from Klamath Falls.

Ascertaining that the Central Oregon Irrigation Company, of Salem, had complied with its part of the contract with the state for the reclamation of land in eastern Oregon, the Desert Land Board has ordered paid over to it \$80,000 in notes given by settlers and held by the state as a guarantee of the company to fulfill its agreement.

Early in August the County Court of Umatilla county granted a petition for formation of the Teel irrigation district, as presented by a committee of land owners. The proposed irrigation project lies south and west of the town of Echo, and contains over 20,000 acres of land. It is situated between Butter creek and the Umatilla meadows.

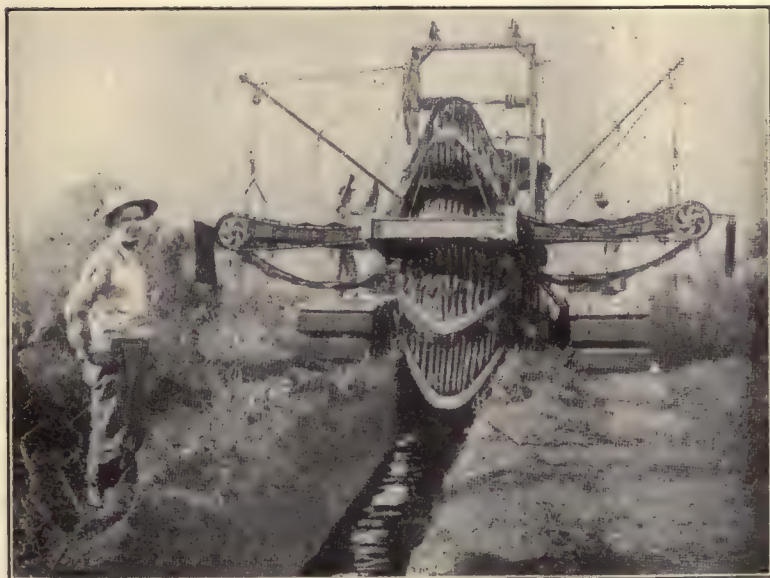
The Secretary of the Interior has awarded contract to the Portland Wood Pipe Company, of Portland, for furnishing and installing about 3,950 lineal feet of wood stave pipe from 18 to 40 inches in diameter, in connection with the Minidoka project in Idaho. The amount of the contract is approximately \$6,000.

UTAH.

The A. H. Snow Development Company, with offices at 116 East Second South street, Salt Lake City, has filed articles of incorporation with the Secretary of State—capitalization, \$50,000. The stock is all subscribed for and fully paid in. A. H. Snow is president, W. H. Cain, vice-president, and C. L. Snow, secretary and treasurer. The company has already taken over a large tract of land in Box Elder county and is draining and reclaiming it for general agricultural use. The company will sell and develop orchards, subdivide and sell small acreage farm lands and deal generally in real estate.

The completion of the Strawberry reclamation project will bring about the irrigation of 14,000 acres of accrescent lands on the south end of the lake, which is included in the land withdrawn from entry some years ago when the proposition of making a reservoir of Utah lake by dyking was under consideration. Water for this land when restored to entry will be taken from Utah lake, the waters of which will be greatly increased by the inflow and seepage from the Strawberry project. The pumps will be operated by electric power obtained from generating plants built by the reclamation service in Spanish Fork canyon and which will be a part of the Strawberry project.

Lowest Cost First and Last With Buckeye Open Ditchers



THE clean-cut, true-to-grade ditch with smooth sloping sides that is made by the Buckeye Open Ditcher, costs less in the first place than ditch dug by hand or by other mechanical devices, and it is easier and far cheaper to maintain a Buckeye-made ditch than any other.

These are the reasons that have made Buckeye Open Ditchers so popular for irrigation and reclamation work in the South and West.

Buckeye Open Ditchers have been in successful use for years—let us tell you where they are and what they are doing.

Write today for Catalog 26.

THE BUCKEYE TRACTION DITCHER COMPANY

FINDLAY, OHIO

Go! Get a Farm Be Independent

in the

San Joaquin Valley California

If you could but see the opportunities offered men and women who will work, you would pack up today and move to this magnificent valley.

There is no other similar area under the stars and stripes where earnest effort will bring such tremendous returns. The California rancher is well-to-do. He came with little and now has much. He found an arid plain, and, by joining with his neighbors, developed water—the results have been little less than miraculous. This pioneering is in the past. You have the advantage of the work that has been done. You go into a finished country needing only intelligent work to bring fortune—independence to you and yours.

There are nearly 10,000,000 acres of arable land and an abundance of water to fertilize it. There are thousands and thousands of these acres that never have felt the vivifying force of ample water. The water is ready and you only are needed with your brain and muscle to make these acres as productive as the best. Go now and buy this land. It is settling fast and the prices are steadily advancing. You still can buy small farms of ten, twenty or forty acres, with water, for from \$125 to \$150 an acre. This same land, planted to alfalfa, will sell for from \$200 to \$300. Can you make money faster? But, once established, you won't sell. This alfalfa will bring you \$40 to \$70 an acre if you sell the hay. If you feed it to dairy cattle, hogs and chickens, your returns will be at least \$100 an acre.

Pretty good for such an investment—don't you think?

And fruit—for this is the home of fruit—is making fortunes every year.

Do you realize that of the 37,000,000 bushels of fruit (not counting apples or citrus fruits) raised in the United States every year, California produces 20,000,000? With this lead, don't you think you could make some money supplying a demand that is increasing faster than the trees can produce?

You can go out and investigate for little money. The Santa Fe sells round-trip homeseekers' tickets to California and elsewhere in the Southwest on the first and third Tuesday of each month—only \$65 from Chicago.

I want to tell you about this marvelous valley. I want you to write today, asking for our two books, "The San Joaquin Valley" and "What California Means for You"—both free. Just send a postcard to

C. L. SEAGRAVES,

Gen'l Colonization Agent, A. T. & S. F. Ry.,

2402 Railway Exchange, Chicago.

The Spring Creek Irrigation Company, of Salt Lake City, has filed an amendment to its articles extending the life of the corporation seventy-five years from date and increasing its capital stock to \$34,900.

TEXAS.

The Littlejohn Irrigation Company with headquarters at Big Wells, was issued a charter early this month. The company is capitalized at \$160,500 and the incorporators are W. H. Littlejohn of Shreveport, La., Wm. McMurray of Big Wells, and O. S. Dowlen, of Springfield, Tenn. The company owns 3,200 acres of fine artesian land located three miles south of Big Wells and fronting on Encena lake, which will be utilized for irrigating the land. Water will also be furnished by artesian wells, and contracts for several have already been let.

A public sale of the entire assets of the Brownsville Irrigation Company will take place October 1st, at Brownsville. The sale will include certain lands, with the irrigating plant consisting of pumps, lifts, flumes, canals and laterals.

E. S. Hunn and associates of Garwood, have sold the Garwood Land & Canal Company to Dr. F. M. Barden and associates. The name of the new company is the Garwood Irrigation Company, with a capital stock of \$100,000. The capacity of the present pumping plant will be increased so that all the land adjacent to Garwood will be supplied with water. G. M. Jackson, of Garwood, is general manager of the company.

Engineers of the reclamation service state that the big flume at Elephant Butte dam can probably be completed by October 1st, so that work on the dam proper can begin soon after that. With the completion of the flume the water will be so diverted that the larger work can be rushed without interference from the river.



ONE MILE A DAY

As a Ditch-Maker and for Reclaiming Arid or Wet Land

The Twentieth Century Ditching Machine

stands without an equal. It will make a mile of ditch 24 inches deep in one day. Is easily operated by one man and can be used with two or four horses as desired. Weighs less than half as much as the heavy grader and does better work at one-half the expense. It will pay every owner of land to learn all about this many purpose irrigation machine. It will not only cut drainage ditches, but levels land, cut laterals, sage brush, throws up dikes, etc.

Write for booklet showing photo reproductions of machine in action, and explaining great money and labor-saving features.

THE BAKER MFG. CO. 526 Hunter Building
CHICAGO

M. A. Lovett, of Abilene, who owns four sections of land near Kermit, will develop it by irrigation with pumps.

WASHINGTON.

Secretary of the Interior Fisher has signed the contract for the High Line Canal for the Kittitas irrigation project. The canal will water 91,000 acres of land in the Kittitas valley, will be 90 miles long, 26 miles from the intake to the junction, the north branch being an additional 50 miles in length and the south branch 14 miles. The water supply for the district will be from the government storage works at Lakes Kaches and Keechelus. The former lake storage reservoir, which will be completed this fall, has a capacity of 165,000 acre-feet, and the latter 210,000 acre-feet. The headworks of the high line canal will be located about 1½ miles west of the town of Easton, and about three miles below the Lake Kaches storage reservoir. Water will be diverted from the Yakima river at an elevation of 2,175 feet by a concrete dam 150 feet long and 50 feet high.

Work of relining the canals of the Okanogan government irrigation project with cement has been resumed, the irrigation season closing August 28. A portion of the canals was lined last spring and the remainder will be completed this fall if possible.

Eliminating all the land owned by the remonstrants, the superior court has granted the petition for the creation of the Paradise irrigation project. This now includes 50,000 acres of dry farm land in the northwestern part of Umatilla county and is to be irrigated by the flood waters of the Umatilla river. The plan calls for the building of a reservoir at the head of Cold Springs canyon, in which the surplus winter flow of the river is to be stored and then transferred to the land to be reclaimed. The promoters declare that the project has been financed and that construction work will start within six months.

(Continued on page 406.)

Books on Irrigation and Drainage

The *Irrigation Age* has established a book department for the benefit of its readers. Any of the following named books on Irrigation and Drainage will be forwarded, postpaid, on receipt of price:

Irrigation Institutions, Elwood Mead	\$1.25
Irrigation Engineering, Herbert M. Wilson.....	4.00
The Primer of Irrigation, Anderson.....	2.00
Irrigation and Drainage, F. H. King.....	1.50
Irrigation for Farm and Garden, Stewart.....	1.00
Irrigating the Farm, Wilcox.....	2.00
Practical Irrigation, Aug. J. Bowie.....	3.00
Practical Design of Irrigation Works, W. G. Bligh	6.00
Irrigation (as a branch of engineering), Hanbury	
Brown	5.00
Earth Slopes, Retaining Walls and Dams, Chas.	
Prelini	2.00
Road Preservation and Dust Prevention, Wm. P.	
Judson	1.50
Practical Farm Drainage, Chas. G. Elliott.....	1.50
Drainage for Profit and Health, Waring.....	1.00
Farm Drainage, French.....	1.00
Land Drainage, Miles.....	1.00
Tile Drainage, Chamberlain.....	.40
Cement Pipe & Tile, Hanson.....	1.00
Arid Agriculture, B. C. Buffum.....	1.50

The Irrigation Age Company,
30 N. Dearborn St., Chicago, Ill.



This splendid 70 gallon vertical suction, centrifugal Buffalo Pump for only

\$28.50

Larger Sizes in Proportion

"Buffalo" Vertical Suction
Centrifugal Pump—the highest
pump value ever offered at the price

We are prepared to make stock shipments from factory of this highly recommended and exceedingly popular irrigation pump, used for heads not exceeding over 50 feet. It belongs to the trade-marked "Buffalo" Class M family, which has won just recognition as the highest value obtainable in popular priced centrifugal pumps. The outfit includes pump, pulley, companion flanges and coupling for both suction and discharge, as shown. Only the finest white babbitt metal is used in the extra long bearings, which are furnished with brass compression grease cups. Thrust bearing is of ball bearing type. It may be installed by attaching the suction flange directly to the well casing, the pump itself being set between two vertical timbers, which also carry the shafting, bearings, etc., and is driven by pulley located above the ground at top of the well. Bearings, shaft collars, and steel shafting can be supplied at a slight extra cost to suit your individual requirements. Being accurately made and fitted, all parts of the pump are interchangeable and can be promptly duplicated at any time. Couplings are bored same size as shaft and bearings. Larger sizes also made. The price quoted is f. o. b. our factory.

Send us your order now.

Ask for Catalog No. 237-C.

BUFFALO STEAM PUMP CO.
Buffalo, N. Y.

Agents Wanted for our complete line of pumps for every purpose

A REMARKABLE WALL LINING.

During recent years there has been a remarkable development in building materials, one of the most popular and practical of which is utility wall board, a substitute for lath and plaster, manufactured by The Heppes Company of Chicago, Ill.

The great problem has been to make a wall board that would not shrink or warp, and that would not contract or expand to any appreciable extent under atmospheric changes, and that would "stay put" once it had been properly applied to the wall and ceiling. By constant experimenting The Heppes Company have practically overcome all these difficulties, and the home builder or contractor can use Utility Wall Board with very satisfactory results.

Utility Wall Board is made in sheets about one-fourth of an inch thick, 32 and 48 inches wide, and in lengths of 5, 6, 7, 8, 9, 10, 11, 12, 14 and 16 feet. It is nailed direct to the studding and joists in new buildings, or it can be applied over cracked or broken plaster in old buildings. It is easily and quickly applied by any one handy with tools. It does away with all the litter, muss and confusion incident to a plaster job, and as the board is perfectly dry when applied the building may be completed much quicker than where plaster is used. It is adaptable to any style or type of building, and to any panel design or style of decoration. It may be painted, kalsomined, papered or covered with burlap, the same as a plastered wall, but with much better results.

Utility Wall Board being put together with two insulations of water, roofing and waterproofed on both sides against atmospheric moisture, makes the building in which it is used a much dryer and more sanitary than any other wall lining.

It is safe to say there is not a new home built in which Utility Wall Board cannot be used to advantage. There is not a garage or summer cottage, an office or factory in which it will not add to the economy and efficiency of the builder's work. And in the houses that are already built the opportunities for using it in repair work or remodeling are almost without number. It is the

handiest material that ever came to hand for building partitions, turning waste spaces into cozy rooms or closets, making clothes chests, wardrobes, etc.

In taking into consideration the cost of Utility Board, as compared with other wall linings, the builder should not consider the initial expense of applying only, but the lasting qualities of the different materials as well. When this board is used the first cost is the last cost, and this factor of permanency and elimination of repairs should be carefully considered.

Very comprehensive descriptive and illustrated literature and a sample of Utility Wall Board may be obtained free by addressing The Heppes Company, Chicago, Ill.

(Continued from page 405.)

MISCELLANEOUS.

A deal has been negotiated for the purchase of a tract of 1,630 acres of land in Finney county, Kansas, by a Garden City company, which will be irrigated and alfalfa grown. A pumping plant will be installed and the entire tract sown to alfalfa. Chas. I. Zirkle & Company was the purchaser.

Ten thousand acres of Kansas land in Gray and Ford counties are to be irrigated from the Eureka ditch. John Gilbert, representative of the operating company at Dodge City, states that the company believes it has developed a water supply for ten thousand acres. Work on the dam across the river at Ingalls has been delayed a month by the high water but work will be resumed within the very near future.

It is reported that a survey is to be run over the proposed route of the big irrigation ditch, which, if found feasible, will carry water to supply a large part of western Stanley county, South Dakota, with water. The proposed plan is to tap the south fork of the Cheyenne river in the vicinity of Cheyenne Falls and to carry the water out to the Bad Lands, where a large natural reservoir is located. The water could then be carried from there along the divide between Bad river and Cheyenne river, and distributed over a large area.

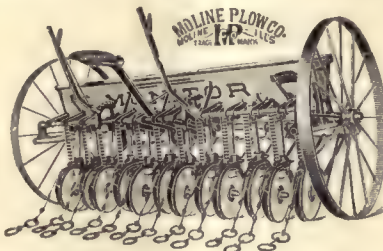


If Bugs, or Hail, or Drouth, or Other Calamity Should Destroy One-Fourth of Your Crop



You would call it a DIRECT LOSS.

What do you call it when BY NOT USING A MONITOR DOUBLE DISC



you raise a FOURTH LESS than you would have raised had you used a Monitor Double Disc?

These are Facts Testified to by Grain Growers Themselves

The Monitor is approximately one-third lighter draft than any other machine of equal capacity. It will work where any other drill will work, and often under conditions where no other drill can work.

It is the only drill that puts all the seed at the bottom of a clean, wide furrow, in two rows, at an even depth, and covers with a uniform amount of earth, by reason of which

It requires one-fifth less seed than other machines—it all grows, no waste.

It increases the yield of wheat usually from three to seven bushels per acre. Other grains in proportion.

Wheat grown from seed sown by it will grade higher and consequently bring a higher price.

The Increase in Yield on Fifty Acres Will Pay for the Drill

MOLINE PLOW CO., Dept. 3, Moline, Ill.
And all Flying Dutchman Dealers.



Trimming for Lining Irrigation Ditches Costs



Improved Type A Machine digging ditch with 8 ft. bottom, $1\frac{1}{2}$ to 1 slopes, 10 ft. deep, 8 ft. berm.

In round figures an average of $1\frac{1}{2}$ cents per square foot of slope and bottom area, according to Government Reports and concrete lining 3 ins. thick costs on an average 15 cts. per square foot including trimming.

Thus 10 per cent of the cost of lining irrigation ditches can be eliminated by ditching with Austin Ditching Machines which excavate ditches with cross-sections cut exactly to templet. These ditches are carved cleanly to shape without disturbing the natural soil beyond the channel limits so that no trimming or shaping is necessary and very little cleaning is required to fit the earth cut for its concrete or other lining. In addition, Austin Ditching Machines will dig ditches at a lower cubic yard cost than they can be dug by any other means.

Austin Ditchers Comprise

Austin Wheel Machines which dig ditches to any bottom width from 18 ins. to 4 ft.

Austin Type R Machines which will dig ditches to any bottom width from 4 ft. to 16 ft.

Austin Type A Machines which will dig ditches to any bottom width from 6 ft. to 20 ft.

Austin Levee Builders which will dig ditches to any bottom width from 20 ft. to 75 ft.

Special Austin Machines are built to dig side hill ditches, ditches with spoil bank graded to form highways, etc.

Full details in Catalogue "S"

F. C. Austin Drainage Excavator Company

AGENTS WANTED IN OPEN TERRITORY

Railway Exchange, Chicago, Ill.

(Continued from page 400.)

A Letter From Chairman George A. Snow of the 20th National Irrigation Congress.

September 10, 1912.

Mr. D. H. Anderson, Editor,
IRRIGATION AGE,
30 S. Dearborn St.,
Chicago, Ill.

Dear Mr. Anderson:

A copy of your last issue of the IRRIGATION AGE has just been handed me and I wish to personally, as well as on behalf of the officials of the congress, express our gratitude and thorough appreciation of the generous mention you have made of the coming Twentieth Annual Session to be held here September 30th to October 3d.

I am sure that your publication will serve a wholesome purpose in increasing interest in and attendance at the congress. I understand from Secretary Hooker that you have kindly consented to send a copy of this issue to each of the appointed delegates as fast as he sends you their names and addresses. I am glad to know this, as this is certain to prove a further substantial aid.

Present indications point to the coming session being one of the most important in point of attendance, the subjects to be discussed and the line of entertainment to be given, of any session thus far held, and I shall feel that you have indeed done much to accomplish this end.

Very truly yours,

GEORGE A. SNOW,
Chairman, Utah Board of Control.

(Continued from page 399.)

There is yet a large body of land near Bayfield in its raw state. Lack of capital to bring this land under irrigation is responsible for that condition. However, we believe that the person who has the perseverance to take up a tract of this vacant land (still subject to homestead entry), clear it of brush and cultivate it he will have a bonanza when the ditch is built for him. We need more energetic farmers.

Our climate is ideal—never too hot or cold. Some seasons there is sufficient moisture that irrigation is unnecessary, especially so in the higher altitudes. In fact many of the ranches tributary to Bayfield, located on branches of Pine river, in the foothills, are not irrigated at all and yet produce enormous crops, and there is never a total failure.

And in conclusion, the Pine river is one of the best trout streams in the state, while all kinds of game exists in the mountains above us.

THE AMERICAN NILE.

Most Diverse River in the United States—Study of Its 300,000-Square-Mile Basin by United States Geological Survey.

For some 2,000 miles the great Colorado river sweeps diagonally across the country from the high mountain plateau of Wyoming and Colorado to the farthest southwest corner of the United States. The basin drained by the Colorado and its tributaries is about 300,000 square miles in area, and much of it is of high industrial and scenic interest.

The Colorado basin comprises two distinct portions. The lower third is but little above the level of the sea, though here and there in it ranges of mountains rise to elevations of 2,000 to 6,000 feet. This part of the valley is bounded on the north by a line of cliffs which present a bold and in many places vertical step of hundreds or thousands of feet to the table land above. The upper two-thirds of the basin stands from 4,000 to 8,000 feet above sea level and is bordered on the east, west, and north by ranges of snow-clad mountains, which attain altitudes ranging from 8,000 to 14,000 feet. Through this plateau the Colorado and its tributaries have cut narrow gorges or canyons in which they flow at almost inaccessible depths. At points where lateral streams enter, the canyons are broken by narrow transverse valleys. The whole upper basin of the Colorado is traversed by a labyrinth of these canyons, many of which are dry during the greater portion of the year and carry water only during the melting of the snow and the brief periods of the autumnal and spring rains.

In the lower portion the river strongly resembles the Nile, having annual floods which distribute silt over the adjoining lands and render them as fertile as those in the historic valley of North Africa. The Colorado and its tributaries are not only of value for irrigation, but, descending in steep channels, they present abundant opportunities for the development of water power. Power has been developed at a few points, but the resources of the Colorado

(Continued on page 410.)



You don't have to undergo the mess and dirt and bother of plastering—you don't have to wait weeks for it to dry only to find it cracked and crazed in a dozen places.

UTILITY WALL BOARD

takes the place of both lath and plaster. It is put on easily and quickly—nailed direct to the studding. There is no muss—no waiting for it to dry—and once in place it is there to stay as long as the house lasts—It will not warp, or crack, or shrink—It may be decorated in any style desired—It is more economical than lath and plaster. *It is the Ideal covering for walls and ceilings.*

Utility Wall Board is peculiarly adapted to the Bungalow type of dwelling and to boat houses, garages, chicken houses and so forth.

Use it in making over the old house as well as in building the new.

Send for a Free Sample—And the Illustrated Book.

THE HEPPE'S COMPANY

4518 Filmore St., Chicago, Ill.

HOTEL UTAH

Salt Lake's Finest Hotel

Official Headquarters for the
National Irrigation Congress

A Noble White Palace Crowning a Hill and Centered in a Setting of Beautiful Gardens

FIREPROOF

400 ROOMS



Rooms single or en suite. Public Dining Room, New Grill and Buffet. All that is best in
Hotel Life at Consistent Rates.

For Reservations during the meeting of the National Irrigation Congress, address

The Hotel Utah Operating Company
Salt Lake City, Utah

Irrigation Age Headquarters During Irrigation Congress, C43 Mezzanine Floor.

(Continued from page 408.)

basin are in this respect yet practically untouched.

Observations by United States Geological Survey.

In a basin so liberally provided with natural resources it is a fundamental necessity, in planning for the utilization of the river, to ascertain

the amount of water available in the main stream and its principal tributaries, so that future developments, as well as those now under construction, can be suitably designed in type and capacity. For a long period of years the United States Geological Survey has been making observations and measurements at many important points in the Colorado basin, and the

latest published information on the subject is contained in Water-Supply Paper 289 of the Survey, by Engineers W. B. Freeman, E. C. La Rue and H. D. Padgett, which is a progress report of river-flow measurements in this basin for the year 1910. Gaging stations were maintained at a large number of river points, covering Grand river and tributaries in Colorado; Green river and tributaries in Utah, Colorado and Wyoming; the San Juan basin in northwestern New Mexico; the Little Colorado river basin in Arizona; and finally the discharge near the mouth of the main stream at Yuma, Ariz. These records are not only of local value for guiding economic development, but they have an international significance in connection with the difficulties that have been encountered in the control of the Colorado near its mouth in Mexican territory.

Necessity for Control of the River.

The control of the Colorado for the prevention of further outbreaks such as its recent diversion into the Salton Sea must involve thorough knowledge of the tributary flow, even in the high regions of its headwaters, in Colorado, and the ultimate steps taken to prevent disastrous inundation will in all probability involve the control of these upland tributaries.

The size of Colorado river is indicated by its discharge at Yuma in the year 1910. The heaviest discharge was in May, 70,300 cubic feet a second; the smallest discharge was in October, 4,300 cubic feet a second.

Planning for the Future of Your Daughter

WRITE FOR INFORMATION ABOUT

COLLEGE
AND
ACADEMY

Saint Mary-of-the-Woods

TERM OPENS
SEPTEMBER
SIXTEENTH

DEGREES CONFERRED: B. A., B. S., PH. B. STRONG FACULTY

Located four miles west of Terre Haute, Indiana. Large campus, perfect drainage, commodious buildings, steam heat, electric lights, large, airy rooms, many with private bath, and spacious halls, libraries and parlors. School plant consists of fourteen modern buildings (two under course of construction), artistically grouped and completely equipped. Nothing lacking for convenience or comfort. Combining all the best features of school life with home environment on a country estate of one thousand acres.

BOATING, HORSEBACK RIDING, SWIMMING, ARCHERY, GOLF and all outdoor athletics for girls under the constant supervision of a graduate of the Sargent School for Physical Education. School course comprises INTERMEDIATE, ACADEMIC and COLLEGIATE departments. Special courses in MUSIC, ART and LANGUAGES. Information gladly furnished on application. A beautifully illustrated catalog to be had for the asking. Address

SISTER SUPERIOR, St. Mary-of-the-Woods, Box 41, Indiana



ARE YOU GOING TO THE TWENTIETH NATIONAL IRRIGATION
CONGRESS AT SALT LAKE CITY, SEPT. 30—OCT. 3, 1912?

You will be pleased with the Service of

THE DENVER AND RIO GRANDE RAILROAD

"The Scenic Line of the World"

The Only Line passing between

Denver, Colorado Springs, Pueblo and Salt Lake City

The Denver and Rio Grande has two separate and distinct routes across the Rockies in Colorado and tickets will be honored via either line. All the important scenic attractions of the Rocky Mountains may be viewed from the car windows without extra expense for side trips.

The Gunnison Tunnel Irrigation Project in Colorado and the Strawberry Valley Irrigation Project in Utah are located on the line of the Rio Grande.

SUPERB DINING CAR SERVICE ON ALL THROUGH TRAINS.

Through Standard and Tourist Sleeping Cars from Chicago, Omaha, St. Louis, Kansas City and Denver to Salt Lake City, Ogden and Pacific Coast Points, Every Day in the Year.

For further detailed information write:

FRANK A. WADLEIGH, General Passenger Agent, Denver, Colo., Dept. 221.

The average discharge for the year was 19,700 cubic feet a second. The total run-off for the year was 14,300,000 acre-feet, which would make a lake a million acres in extent and 14.3 feet in depth.

A copy of the Colorado river report for 1910 may be obtained free on application to the Director of the Geological Survey, Washington, D. C. Copies of the corresponding report for 1909 and for 1908 are also available.

PLANTING ONION SEEDS.

The Experiment Station of State College, N. M., has conducted experiments in the growing of onions by transplanting from a seed bed to the field and by planting the seed in the field where the onions were to grow, and when large enough, thinning them in the row to the proper distance. It has been found, that everything considered, the transplanting plan is the best and most economical. The thinning of onions in the field beds is exceedingly tedious and expensive, under our method of irrigation. Aside from the extra work and cost of thinning, there are always considerably more weeds in these beds, which make it necessary to start weeding earlier and more frequently. In the germination of onion seed under field conditions there are always a few places, though small they may be, where the seed fails to come up. In these vacant places onions must be transplanted in order to have a uniform stand in the row.

In order to grow onions by the transplanting method, the seed must be started in the fall or winter. The results at the experiment station show that the best seeding period is comparatively short. That is to say, if the seed is planted too early, most

of the plants will go to seed the following summer. If, on the other hand, the seed is planted too late, the young plants will not be large enough for transplanting at the proper time in the spring. This "best period of seed-
(Continued on page 412.)

The Good Farmer Watches His Sluices

Every canal and side ditch should be constructed in the best possible manner and kept clear; the sluice gates should be kept in the best condition always, because water is mighty precious sometimes. The farmer who is careful of his ditches is equally careful in the buying of rubber boots. He knows that perfect foot protection means good health.

The best boot sold anywhere is the

Woonsocket Elephant Head Rubber Boot

If you have to wade a cross ditch, or perform any piece of muddy work, this is the boot you want, because:

It won't leak. Reinforced at every wearing point. See the extra strip on the seam. Made of the best grade pure rubber, backed by canvas and lined with wool net.

It has pleased thousands of farmers and it will please you. Buy it today from your dealer. Look for the Elephant Head trade mark.



Woonsocket Rubber Co.
Woonsocket, R. I.

GALVANIZED METAL IRRIGATION FLUMES

(Newcomb Patent)



Made entirely of rust-proof, galvanized iron. No bolts or rivets used in construction.

This flume is considered by experts to be the most serviceable equipment for the purpose on the market.

A careful examination of the construction as shown herewith will convince those who are acquainted



with irrigation conditions of its lasting quality and the ease with which it may be put together.

Complete information, with prices, will be furnished on application to the

KLAUER MANUFACTURING CO., Dubuque, Iowa

(Continued from page 393.)

in American schemes that are only partly productive, the IRRIGATION AGE believes that an investigation ought to be made of the Victorian methods and results. It suggests that the government send some one to Victoria to report on this. It would, at least, have many suggestions which would have practical value in working out our own problems.

Mr. Mead's visit to this country is partly private and in part to study the methods of giving practical instruction in agriculture followed in some of the leading agricultural colleges of this country. One feature of the Victorian settlement work is the giving of practical advice to

the beginners and a study is being made of American methods in order that our experience may be utilized.

KEYSTONE DRILLER COMPANY OPENS NEW BRANCH OFFICE.

Keystone Driller Company, of Beaver Falls, Pa., announce the establishment of a Southern branch office at 1629 Chandler Building, Atlanta, Ga. The office is in charge of Mr. McCarthy, who will look after the sale of the Keystone well drilling machinery and Downie deep well pumps in the Southern states.

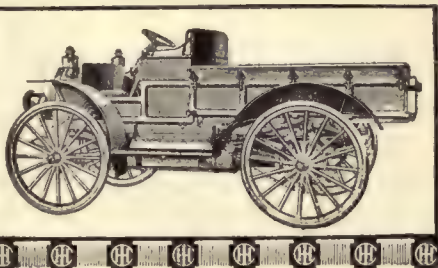
\$5.00

Genuine Navajo Blankets

My business is done directly with the Navajo Indians, whose reservation is near Aztec. I make trips to the reservation and purchase the best in the line of Navajo rugs and blankets direct from the Indian weaver. I have no middleman to pay. Why pay \$20 to \$50 for a Navajo rug or blanket in a Chicago store when I can sell you the finest quality from \$5 to \$35, depending on size. If not satisfied after examination I will refund your money, and I refer to the Citizens Bank of Aztec as to my responsibility. Before buying a Navajo rug or blanket write me telling me size you want and get my prices.

J. F. WOOD,

Aztec, New Mexico



A Good-Looking, Dependable Business Wagon

THERE'S a look of sturdy reliability and independence about an International auto wagon that makes friends for it wherever it goes. The car is just as reliable and dependable as its looks indicate. In endurance contests it equals cars costing three times as much. In economy it stands at the head of its class. In dependability and all-round utility it beats them all.

Every day you run an International auto wagon you will find it more useful to you. With it you can make the trips you used to neglect, because you did not want to take the horses from their work. Perishable products are handled speedily, or taken to the most profitable market. Best of all, the car saves money as well as makes it.

International Auto Wagons

help make farm life pleasant. It is a pleasure to run the car and it is so reliable, so ready to go at any time or for any purpose that it soon becomes indispensable. It can be used in all seasons when the road is passable to horses. The wheels are high enough to give ample road clearance. Solid tires give good traction and eliminate many tire troubles. The engine is simple and powerful. Fuel and oil to run an International auto wagon cost less than the feed for a horse, while the wagon will do from two to four times as much work.

It will pay you in many ways to know all about the International auto wagon. A letter to the nearest branch house brings full particulars with many interesting facts.

WESTERN BRANCH HOUSES: Denver, Col.; Helena, Mont.; Portland, Ore.; Spokane, Wash.; Salt Lake City, Utah; San Francisco, Cal.

International Harvester Company of America

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000 Harvester Building

Chicago U S A

I H C Service Bureau

The purpose of this Bureau is to furnish, free of charge to all, the best information obtainable on better farming. If you have any worthy questions concerning soils, crops, land drainage, irrigation, fertilizer, etc., make your inquiries specific and send them to I H C Service Bureau, Harvester Building, Chicago, U S A



Weeds practically destroy the flow of water in irrigation canals, rivers, etc. at many places, and prevent them from yielding their full capacity; besides being a nuisance in reservoirs, lakes, etc.

THE SUBMARINE WEED CUTTING SAW

does away with insufficient and laborious methods of clearing. It is easily operated from the banks, or, on large lakes just as well from



Weeds Cut and Floating Down Stream

ASCHELT BROS., Cedar Lake, West Bend, Wis.

boats, and cuts the weeds at the ROOTS. Employed by different departments of the U. S. Government, several States and many cities, and highly recommended by water users here and abroad. Write for illustrated circular and references.

(Continued from page 411.)

ing" has been found to be, at the experiment station, from about the 20th of September to the 10th of October. The practice at the station is to plant the seed in the field seed beds about the last of September. This period of starting the seed may vary a little, according to the altitude and climatic conditions in different parts of the state. The grower should, however, keep in mind not to start the seed too early or too late, or else the plants will either go to seed or not be large enough for transplanting at the proper time in the spring.

The preparation of the seed bed is of much importance. The land should be plowed thoroughly, and disked or acmed, if necessary. It should be gotten as level as possible. It is best not to have the beds or plats too large. If the soil is somewhat light, it is advised that a light dressing of well-rotted manure be put on it, and be disked in before the seed is planted.

The seed can be drilled in rows about 4 inches apart. This is best done by using a garden drill, such as the Planet Junior. Great care should be taken in regard to the depth. If it were possible under field conditions, it would be best to have the seed about 1/2-inch in depth. Since this is a hard matter to do, 3/4-inch to 1-inch depth should be the limit. Immediately after planting the seed it should be irrigated, to produce germination. As a rule, another irrigation is given the plats while the plants are coming through and before germination is completed. During the winter two or three irrigations may be given the seed bed. The number of these irrigations will depend upon the winter—whether it is dry or wet. If the germination were ideal and everything went on all right during the winter, we could probably count on

three pounds of seed producing enough plants for one acre, but to be on the safe side in practice, we usually count on four to five pounds of seed. The winter temperatures in the Mesilla Valley do not injure the little onion plants. During the last two winters they have stood a zero temperature without material injury.

In the Mesilla Valley it is the practice to transplant from the first to the fifteenth of March. Transplanting at this time gives the best results. The later the transplanting is done the poorer the results. The old rule in regard to the proper size of onions for transplanting was that the onion was ready for transplanting when it was as large as a pencil. This rule does not have to be followed in the transplanting of this crop in this climate, as all of the onions are transplanted long before they are that large. Oftentimes when they are not more than twice as large as a toothpick.

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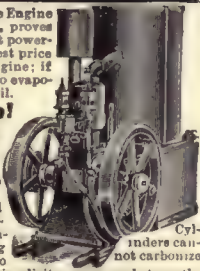
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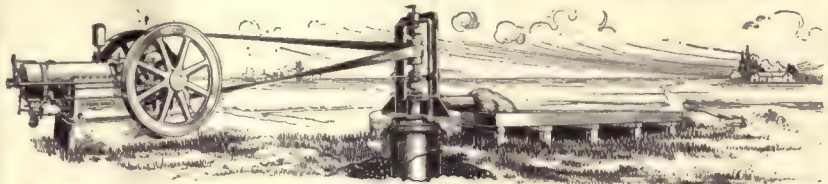


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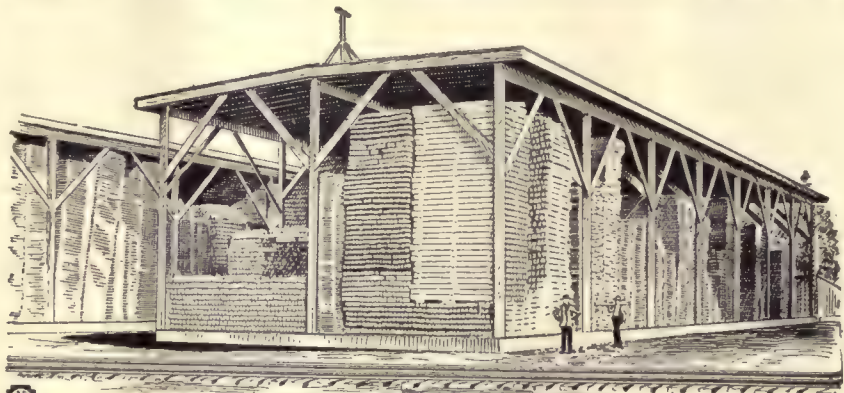


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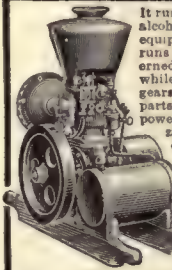
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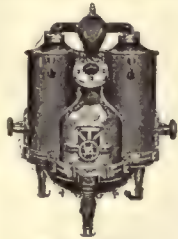


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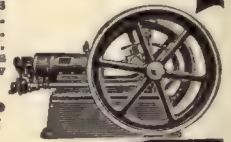
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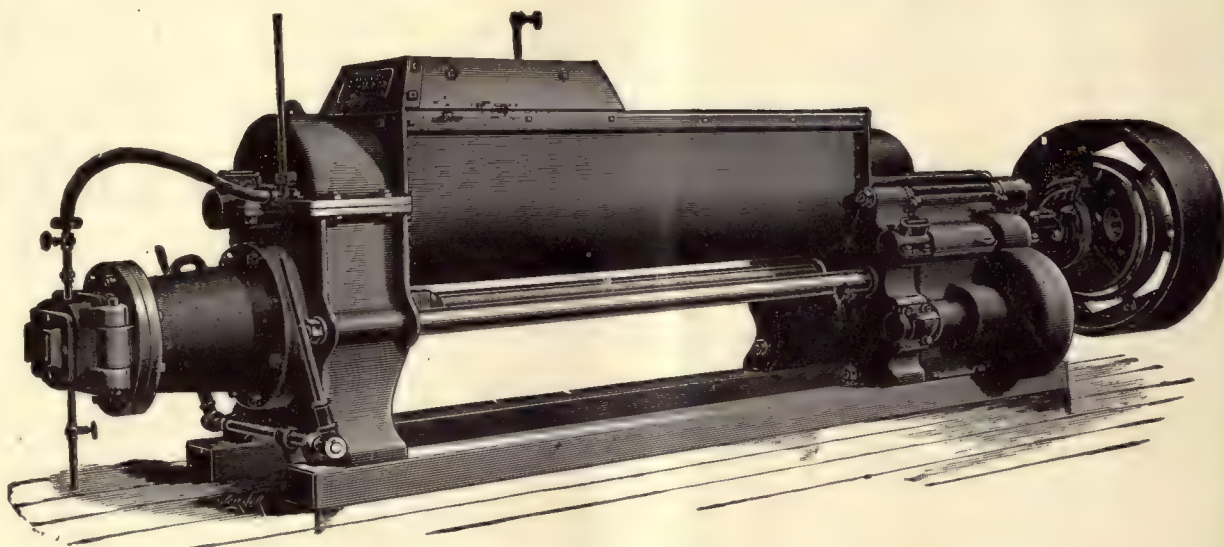
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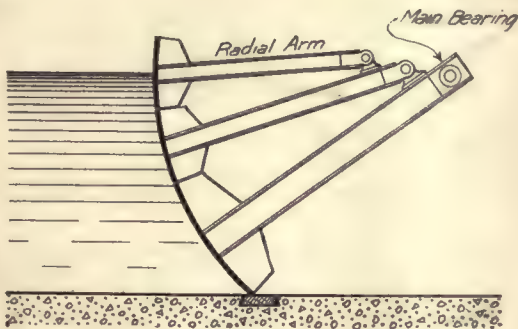
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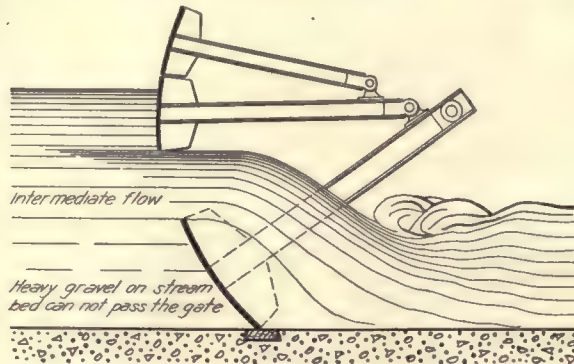
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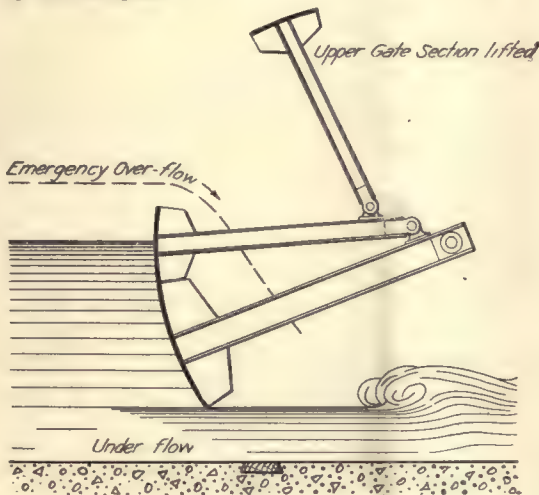


GATE RAISED FOR INTER-MEDIATE FLOW
(Head-gate example)

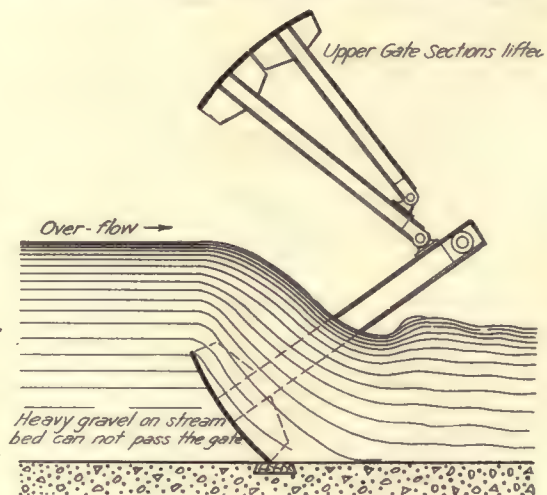
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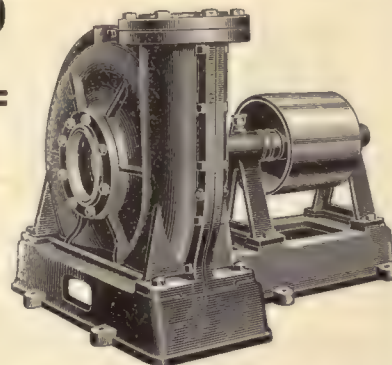
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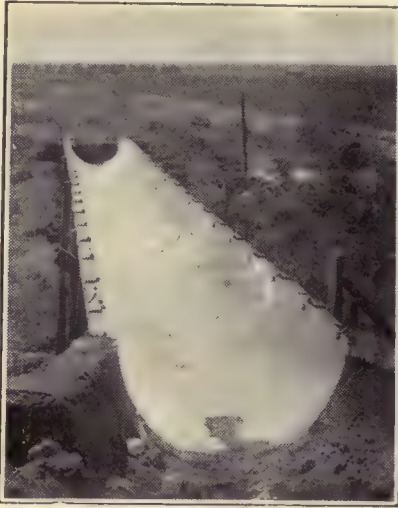
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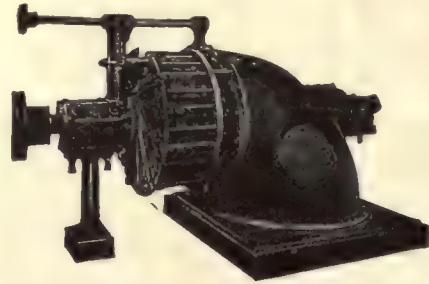
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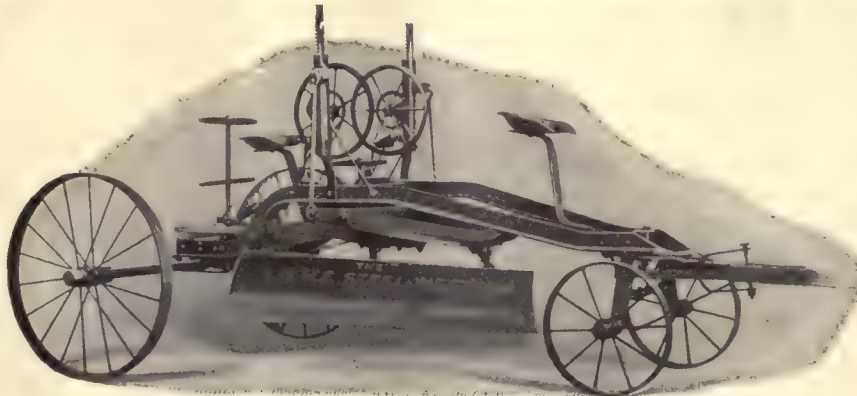
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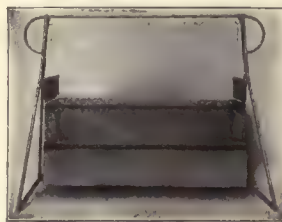


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Twenty-seventh Year

THE IRRIGATION AGE

VOL. XXVII

CHICAGO, OCTOBER, 1912.

No. 12

THE IRRIGATION AGE

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THE IRRIGATION ERA
ARID AMERICA

THE DRAINAGE JOURNAL
MID-WEST
THE FARM HERALD

D. H. ANDERSON
PUBLISHER,

30 No. Dearborn Street, - - CHICAGO
Old No. 112 Dearborn St.

Entered as second-class matter October 3, 1897, at the
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D. H. ANDERSON, Editor

ANNOUNCEMENT.

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only publication in the world having an actual paid in advance
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readers in all parts of the world. *The Irrigation Age* is 27 years
old and is the pioneer publication of its class in the world.

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Irrigation

Securities

Show Strength

and Improvement.

There seems to be a vast improvement
in the development of irrigation proj-
ects and the strengthening of irrigation
securities throughout the west.
On a recent visit through Colorado,
Wyoming and Utah, the writer learned
that there is a much better feeling in money centers con-
cerning irrigation bonds, and this will, no doubt, result in
the rehabilitation of many projects which have laid dor-
mant for a number of years owing to lack of knowledge
on the part of capitalists of the physical features of the
various projects, as well as the ultimate profit to be de-
rived from a bonding basis.

Over

Irrigation

A

Menace.

We are publishing in this issue of *THE IRRIGATION AGE* an article on the irri-
gation of alfalfa by Professor Alfred
Atkinson of the Montana Agricultural
Experiment Station. We are also repro-
ducing a paper delivered by Professor
W. J. Elliott before the Western Canada Irrigation Asso-
ciation at Kelowna, B. C. Professor Elliott is superin-
tendent of agriculture of the department of natural re-
sources of the C. P. Railroad.

It will be noted by a perusal of these articles the im-
portance attached to the matter of over-irrigating.

It is well worth the while of all of our readers who
are actively engaged in irrigation farming to study these
articles carefully.

**Platform
Twentieth
Irrigation
Congress.**

Those who scan the platform of the 1912 congress and who are in a position to compare it with resolutions passed by former congresses, will note a curtailment of subjects under consideration and a tendency towards condensation in the subjects covered.

It may, perhaps, be a good plan, but it is doubtful if the Resolutions Committee has shown good insight into the affairs as have similar committees in congresses held in the past.

A cursory perusal of the resolutions would lead one to believe that there was an inclination to pass over, as lightly as possible, all subjects handled, and there were, no doubt, many good resolutions fought for and tabled which would have been of vastly more importance than those enumerated in the platform of the Twentieth Irrigation Congress.

**Kinney
On Irrigation
and
Water Rights.**

Judge Clesson S. Kinney, the author of "Kinney on Irrigation and Water Rights," informs us that the revised edition will be ready for delivery in complete form—four large volumes in buckram—about December 1 of this

year. Two volumes are already out, and Judge Kinney states that the other two will probably be ready for delivery at the time mentioned.

The first edition of this work, which was published in 1893, had a tremendous sale and met with the approval of both bench and bar, and has been cited by the courts more than any other work on the subject.

The new edition gives the history and development of the leading irrigation laws and water rights down to October 1, 1912.

The value of water and water rights and the numerous recent statutes on the subject have given rise to many new and important provisions of law which may be found discussed nowhere except in this new edition. All matters, old and new, relating to irrigation and water rights have been given that technical and comprehensive discussion which their importance demands.

More than 4,500 decisions are cited and used in this work. This work has developed from its former limited size to four large volumes of 4,400 pages.

**Irrigation Age
Beginning
Twenty-eighth
Year.**

Our issue of November, 1912, will mark the beginning of the twenty-eighth year of the existence of THE IRRIGATION AGE, which was the pioneer publication of this class in the world, having been published continuously in that interest

for twenty-seven years.

It is our intention to make the November issue a special one, covering, as far as possible, in a historical way, the development of various irrigation work during the period of its existence. We will touch also upon earlier irrigation which will interest all of those who have been identified with the movement since its inception.

We will, perhaps, decide to get up something elaborate in the way of a special edition to mark the twenty-eighth anniversary, and if arrangements now pending are consummated, we will be able to announce the absorption of another journal by THE IRRIGATION AGE, and the merging of the circulation of that publication with that of the AGE.

This change will bring to THE IRRIGATION AGE several thousand new subscribers, all of whom are possible buyers of machinery and other lines manufactured for use in the irrigated country. It will place the AGE back in its old position as the only distinct irrigation publication in the known world. As is known to many of our readers, THE IRRIGATION AGE has absorbed during the past ten years six other publications issued along similar lines, the circulation of which has been made part of the regular subscription list of this journal.

**Meeting Place
Twenty-first
International Irri-
gation Congress.**

Phoenix, Arizona, has been named as the next meeting place of the International Irrigation Congress.

It was, no doubt, the desire of the citizens of that city to secure the congress so that better information may be obtained by people in outlying states concerning the work performed upon the famous Roosevelt dam erected near that city.

There are many delightful features about Phoenix, and the delegates who attend in 1913 will be well repaid for their trip.

Phoenix is a long distance away; in fact, it is as far from Chicago as Los Angeles, owing to the fact that it is off the main line of the two trans-continental lines. It is located in the famous Salt River valley, where irrigation of a prehistoric character as well as that more modern may be inspected.

It is said that the Roosevelt dam in itself is worth the trip to that section, and this point will, no doubt, attract many who have never seen any of the larger engineering works connected with the work of the reclamation service.

The last Irrigation Congress held in Phoenix was in 1896, some eight years prior to the passage of the Irrigation Law. It was at this congress that George H. Maxwell, and some others who subsequently became active in the work, entered the arena.

As one looks back over the field and counts the large number of those who attended that congress who are gone, and who were then active and vigorous, we wonder what changes may take place in the personnel of the congresses to be held a few years hence. There are very few of the "old timers" who took part in that Phoenix congress who were in attendance at the congress recently held in Salt Lake. Among those were Messrs. Knight of Missouri, George H. Maxwell of California, Judge Shurtliff of Utah, and the writer.

**Important
Resolution
Offered at Irriga-
tion Congress.**

One of the resolutions passed at the late irrigation congress is of particular importance, as it treats of a change in the Reclamation Law so as to require all contracts for the sale of power developed by or in connection with any

reclamation project to be approved by the project water users' association under such project having an interest in such contract.

This is a wise suggestion and should receive the attention of those who are making a study of amending the Reclamation Law.

This resolution goes on to say: "While we recognize the establishment of the United States Reclamation Service as second only in importance to the passage of the Reclamation Act in the development of the arid west, experience has demonstrated the expediency of certain ad-

ministrative changes." The change mentioned in our earlier lines seems to be the only particular change mentioned in this connection, and it is our impression that this does not go far enough, as there are many opportunities for changes to better the reclamation law.

The resolution also recommends that complete plans and specifications for any project should be delivered to the project water users' association before such work is begun, and that itemized semi-annual reports of all charges and expenditures under each reclamation project should be furnished to the water users' association under such project.

The resolution, moreover, favors the appointment of a consulting engineer under each project, to be selected by and paid by the project water users' association, who will have access to the plans, specifications and accounts, but who will be without supervisory power. This latter recommendation is of the utmost importance to the members of the water users' associations, as it will enable them to keep in close touch with all of the development work on the project through such an official who may ask for and secure such information where the individual water user would probably be ignored by the local project engineer.

Slandering A Well Developed Irrigated Valley.

A leading magazine published in a central state has evidently been imposed on by writers who are either irresponsible or lacking in information, in an article which recently appeared concerning the Los Angeles aqueduct in the Owens Valley of California. A certain Mr. Wm. Atherton De Puy recently published an article in which he states:

"The city of Los Angeles has recently acquired, as a storage reservoir, a stretch of barren desert known as Owens Valley. As far as the eye can reach this valley is a barren and alkaline waste. All effort to develop this valley into a community in which men could earn a livelihood has failed. It appears to be an absolutely useless portion of waste land."

That Mr. Du Puy has never seen Owens Valley is evident from the tenor of his article.

The Owens Valley is one of the most delightful sections in the western country, and wherever water has been applied the land shows wonderful capacity for the support of agricultural pursuits and orchard development.

The writer spent some time in the Owens Valley a year or more ago, and saw a territory well irrigated and under a high state of cultivation near Bishop and Independence.

In this valley are many thriving towns, the two most important being Bishop and Independence. There are also very many well developed ranches on the mountain plateaus as one goes up westward from the Valley. The writer has in mind one ranch immediately west of Big Pine which is in a high state of cultivation, and altogether one of the most delightful spots that he has ever visited.

It will occur to those who are familiar with this famous section of the west, that men of intelligence sufficient to write good descriptive English will allow themselves to be misled by conniving individuals who are evidently trying to belittle a section for the benefit of larger interests who wish to control the water supply. This is evidently the basis of the article.

People of Owens Valley should take some steps to correct misstatements of this character.

The Twentieth National Irrigation Congress.

The Twentieth National Irrigation Congress has come and gone, and those who attended will have no regrets on the score of lack of entertainment, either from the citizens of Salt Lake City or through the speeches and various papers delivered at the various sessions of this congress.

Many topics of importance were handled, and it is our intention to touch upon them from time to time during the coming months.

One subject in particular which was discussed by the daily newspapers of Salt Lake was the governmental management of reclamation projects.

This was bitterly attacked by John C. Bell of Colorado, who referred to some of the government agents connected with the operation of projects and compared them to an old-time mail carrier who would refuse to turn out for a person on the road because he was employed by Uncle Sam. Mr. Bell declared that an agent of the government is more liable to abuse the public than an agent of a corporation, and insisted that many projects are brought into disrepute merely through the incompetency of government representatives.

Mr. Bell went on to say that men at the head of these irrigation projects, like Mr. Newell and others, do not believe what they hear concerning their local representatives because they do not investigate complaints. He further stated that the people on projects with which he is familiar are up in arms against the government agents or representatives of the Reclamation Service. He stated that the people lacked confidence in them and criticised them very severely.

It is doubtful if Mr. Bell has made inquiries as to whether or not Mr. Newell has made investigations. It is our impression that Mr. Newell would be very glad indeed to investigate and correct any flagrant abuse of power on the part of a government agent in his department.

There is, however, a tendency, particularly among engineers, to clannishness, or, to put it more properly, a sort of a professional reserve that prevents one engineer from giving information concerning another where it would be injurious to his co-worker.

THE IRRIGATION AGE is well aware that it would be difficult, for instance, to criticise and get results on such a project as the Belle Fourche, in South Dakota. The government officials on this tract form a sort of a close corporation and, while many of them are high grade men who understand that there are incompetent ones among them, and who may also understand that there are men among them who are inclined to be discourteous to the settlers, would not admit that much to a superior officer like Mr. Newell, and this in turn leaves the entire force open to severe criticism.

The sooner the average engineer on a project learns that a kahki uniform and a cow-boy hat does not constitute authority nor always indicate a high grade of intelligence, just so soon will the service be bettered.

It is unquestionably the duty of officials higher up to look after conditions of this character and make it as easy as possible for settlers upon the tract who may have other difficulties to overcome. There is, perhaps, no more disagreeable feature to be encountered in the development of a new tract on the part of a new settler than the arrogance and overbearing attitude of a stripling engineer.

It is the opinion of the editor of IRRIGATION AGE that all complaints should be made direct to Mr. Newell, who would, no doubt, be glad to investigate.

TWENTIETH INTERNATIONAL IRRIGATION CONGRESS

Held at Salt Lake City, Utah, September 30 to October 4, 1912

The Twentieth International Irrigation Congress, sessions of which were held in Salt Lake City, Utah, September 30 to October 4, proved to be one of the best meetings of that character in the history of the organization.

There were in attendance some 1,200 to 1,400 accredited delegates, a large number of whom were active in the proceedings of the Congress.

Owing to the fact that the Utah State Fair was held during the same week and the semi-annual conference of the Mormon Church was also in session at that time, immense crowds were attracted to the city by the inland sea.

The citizens of Salt Lake City and Utah did everything in their power to make the visit of the delegates pleasant and the city was more profusely decorated than ever before in its history.

Salt Lake City in itself, independent of any outside attraction, possesses an unusual amount of entertainment for visitors from other states. It is the Mecca of the Mormon Church, and here are located the famous tabernacle, the world known temple, and all of the governmental buildings of that great institution.

Speeches replete with constructive ideas on many land and irrigation topics were delivered by men of prominence and authority on the subjects with which they dealt. Several speeches provoked spirited discussion among the delegates, showing the aggressive and earnest purpose of the delegates.

Perhaps the most attractive feature of the entire congress was the gorgeous pageant whose beginning had been signalized by the formal opening of the congress at the tabernacle on September 30. At that time the queen of irrigation, her maids of honor, officers of the congress and other dignitaries were presented to the delegates and the public.

It is doubtful if any former meeting of the congress had a more impressive opening; in fact, to an onlooker in the tabernacle during the opening exercises, the stage settings with the great choir and organ in the background, the queen and her maids of honor and the prominent officers and visitors to the congress in the foreground, with a sea of 14,000 faces surrounding them on the main floor and in the gallery of the world-famed building; was intensely impressive. The size of the building and great crowd combined to make it the most impressive gathering ever attended by the writer.

The singing of the "Star-Spangled Banner," followed by the introductory speeches of the various officials, including the governor, officers of the congress, etc., consumed a good part of the opening day.

Fine as was the rendition of the ode to irrigation, interesting as was the ceremonies that marked the great gathering, the feature of the day which exceeded anything of like nature which has ever taken place in Utah or in connection with an irrigation congress was the glittering pageant of the evening.

Thousands of dollars and days of labor had been ex-

pended on this pageant. The board of control, working through Douglas White, who had charge of all arrangements for the parade, with his aides gave to Salt Lake and Utah something unprecedented in her history.

The afternoon session of the first day took up the discussion of questions of importance, this and subsequent meetings were held in the assembly hall.

The opening address before the congress was made by George A. Snow, chairman of the Utah board of control. This was followed by addresses of other notables, which finished the preliminary meeting.



GEORGE A. SNOW,

Chairman Executive Committee Twentieth National Irrigation Congress

An attempt to bring about the merger of the irrigation congress with the dry farming congress on the ground that the interests of the dry farmer and the irrigation farmer were identical in the end and that the merger would prove profitable to both organizations brought forth a storm of protest at the morning session. George H. Maxwell made his usual effort to put this merger over, evidently thinking that it would strengthen his position in the matter of the deep waterways problem which is now under way.

The credit for blocking this move is due, largely, to D. H. Wilkie of Utah and Thomas Knight of Missouri, who declared that the irrigation congress had accomplished mighty things in its line and would continue to do so under its own flag, whereas a union with an organization in some ways directly opposite in its aims might develop obstacles. Mr. Knight urged sticking right to the proposition of irrigation while there remains an arid acre capable of being brought under the magic touch of water.

Another suggestion, broader in scope than the first, urging the combination of the Irrigation Congress, the National Reclamation Association, the Dry Farming Congress, the Trans-Mississippi Commercial Congress and some other public organizations was presented to the meeting by advocates of the plan. This also called forth much protest, many of the delegates declaring vehemently that the Irrigation Congress should not lose its identity after twenty-one years of honorable and successful achievement.

Among the foreign delegates who either spoke or sent written greetings were Niel Nielson of Australia, William H. Fairfield and Norman S. Rankin of Canada, Senor Lopes Ferreria of Portugal, Juan Padilla of Guatemala, Professor George Von Wendt of Finland, Vivaldo Coaracy of Brazil and Romulo Escobar of Mexico. A paper by Elwood Mead, chairman of the State River and Water Supply Commission of Australia, was read at the evening session, Mr. Mead was unable to be present.

It was decided to hold the next congress at Phoenix, Arizona.

The following officers were elected: Major Richard W. Young, Salt Lake City, Utah, president; J. B. Case, Abilene, Kans., first vice-president; John Fairweather, Fresno, Cal., second vice-president; S. H. Lea, Pierre, S. D., third vice-president; Richard F. Burges, El Paso, Tex., fourth vice-president; Kurt Grunwald, Pueblo, Colo., fifth vice-president; Arthur Hooker, Spokane, Wash., secretary.

Following are members of the Executive Committee: P. S. Lack, Phoenix, Ariz.; John A. Fox, Arkansas; Douglas White, Los Angeles, Cal.; Dr. C. W. Dixon, Kelowna, B. C., Canada; Lou D. Sweet, Denver, Colo.; Frida D. Sanford, Derby, Conn.; C. J. Blanchard, Washington, D. C.; C. M. Hill, Boise, Idaho; D. H. Anderson, Chicago, Ill.; M. F. P. Costelloe, Ames, Iowa; Mrs. Charles B. Andrews, Kansas; George H. Maxwell, New Orleans, La.; F. L. Vandegrift, Kansas City, Mo.; L. Newman, Great Falls, Mont.; Prof. O. V. P. Stout, Lincoln, Neb.; James G. Givens, Las Vegas, Nev.; W. S. Hopewell, Albuquerque, N. M.; Trueman G. Palmer, New York; E. F. Bohm, Cleveland, Ohio; Harley J. Hooker, Altus, Okla.; J. T. Hinkle, Hermiston, Ore.; Morris Knowles, Pittsburgh, Pa.; C. L. Millett, Fort Pierre, S. D.; J. A. Smith, El Paso, Tex.; George A. Snow, Salt Lake City, Utah; R. Insinger, Spokane, Wash.

SOME PHASES OF IRRIGATION IN RELATION TO FRUIT GROWING.

An Address by Prof. C. I. Lewis of the Oregon Agricultural College Before the Western Canada Irrigation Congress at Kelowna, B. C.

In considering the relation of fruit growing to irrigation, two pictures immediately come to my mind and they illustrate pretty nearly the present status of irrigation and fruit growing.

In the first case I see a lot of soft, spongy apples of poor quality, watery peaches and insipid cherries—fruit which neither keeps nor ships well. I see the orchard dying, the seepage pools creeping among the trees and the alkali doing its deadly work. Winter injury is also taking its toll, and various diseases are playing havoc among the trees. If this is the consequence of correct irrigation, then irrigation as related to fruit growing is surely a curse. While this picture too often is true, it should be the great exception and not the rule.

The other picture that I see is orchards in the finest of vigor, producing maximum yields of fruit which they bear annually and the fruit is much improved in quality, being more juicy and palatable. The fruit is found to be of a larger size, of a brighter or more lively color. We find that more intercropping is practiced among the trees successfully, there are less windfalls and culls usually, and if this is a true picture, irrigation becomes one of the greatest blessings of the country.

In traveling quite extensively over the Pacific coast I have seen these pictures repeated over and over. One man says it is impossible to grow good fruit with irrigation, another that it can not be grown without irrigation. The fact is irrigation should have no different effect on the fruit than natural rainfall.

A great advantage in irrigation lies in the absolute moisture control of the soil. The trouble with irrigation lies in the fact that we are constantly blaming the science of irrigation when we should blame the ignorant irrigator. We have not made irrigation the science it should be. We have been more interested in how much water to use rather than how little. We have not emphasized sufficiently the importance of drainage in irrigation. Also, we need to practice a more intelligent interplanting of our fruits. It is a common practice to grow all classes of fruit on the same piece of soil under irrigation. While they can be grown and marketed at a profit, it is very rarely that they can all be grown to the highest degree of perfection. Take peaches, for example; it is most unwise to irrigate peaches up to within three weeks of harvesting; on the other hand, if this rule were followed closely, the apple trees planted among the peaches might suffer. Undoubtedly we are at times tempted to grow too large a specimen and too much fruit to the tree at the expense of quality.

Up to the present time we have spent most of our energies on the engineering phases of the irrigation problem. This was necessary, as these projects had to be started and the water distributed. Having received the water, we simply poured it on and expected nature would do the rest. Generally our expectations have been fulfilled, although nature does not always pay us in the way we anticipate.

The division of horticulture of the Oregon Agricultural College and Experiment Station has been working on irrigation problems for five years. This work has been carried on in southern Oregon fruit districts, in the home station at Corvallis, and in eastern Oregon at Hermiston, where we have a 40-acre irrigation experiment station.

In regard to the bearing fruit trees, in our work we have made a study of the subject in a broad way, but it will be a number of years before complete data can be secured. We have studied the date of application of irrigation water, amount applied, the kind of water to use, whether river, well or spring; temperature of water at its point of source and as it reaches the land; the depth of percolation and spread by capilarity, and the drainage.

Send \$1.00 for 1 year's subscription to the IRRIGATION AGE and bound copy of THE PRIMER OF IRRIGATION. If you desire a copy of The Primer of Hydraulics add \$2.50 to above price.

In considering the soil, we first made a study of its general composition, such as clay, gravel, free soils, pumice or volcanic ash. This included a close study of the sub-soil as well as the top soil, as often the sub-soil is more important than the top soil. Mechanical conditions were investigated and the question as to whether the soils are full of humus or deficient. After the water was applied we have studied the soil carefully as to its tendency to puddle or pack or its characteristic of cracking as it dries.

We have taken into consideration the relation of cultivation to irrigation and have compared tilled soils with those that are both tilled and irrigated. The temperature of the soil, including the sub-soil before and after irrigating, has been investigated, and the rapidity with which water travels through the furrow and percolates through the soil.

As concerns the fruit, we have noted whether there are any changes in color. Is the size influenced? What are the percentage of large, medium and small apples secured from different amounts of water? The firmness, shipping and keeping quality, total yields, the form of the fruit, its time of maturity and a chemical study have all been made.

We have already studied carefully the chemical compositions of the apple as influenced by irrigation over a

we found it possible to complete certain lines that we have begun on. We are continuing this work from year to year and hope the future will give us more information relating to the true duty of water in fruit production.

It must, of course, be understood that from the start that irrigation of an orchard means that such individual grower must study his problem carefully himself, and while he will be able to get a good deal of information from the experience of others, he will have to work out the special application under his own peculiar conditions. The age of his trees, variety, type of his soil, the average climatic conditions, will all influence his problem. If, however, we can get the grower interested in studying his problem carefully and realizing the importance of such a study, we have won a great victory, especially if we can teach him that he should work on the basis of how little water is necessary rather than how much, and that irrigation cannot successfully be made to take the place of tillage. The irrigator must be led to learn that he is certainly his brother's keeper. If his neighbor suffers because of his unwise irrigation, sooner or later he will suffer himself.

In our work we have found that irrigation aided in giving us a larger percentage of fruit that came up to good packing size. This meant that there was a smaller per-



Orchard Irrigation Experiment at the Oregon Agricultural College.

period of two seasons. This needs to be carried over a series of years in order to give conclusive results which can be published. We have studied the tree itself, concerning bud and wood growth, the effect on wood growth and the effect on the tree in a general way; the relation of irrigation to the terminal buds according to their size. Are they large or small, firm or soft? Is the percentage of fruit buds increased by irrigation? What is the average growth and length and diameter of the annual growth? At what date does the wood ripen? Is it affected by frosts or winter injury? Is the foliage vigorous? How is its color influenced? At what time does it color in the fall? What is the date of the droppings of the foliage?

We studied the tissue and cell structures of the fruit, leaf and wood. We must, of course, take into consideration the age and vigor of the trees and the way they have been cultivated and pruned.

The division of horticulture of the college has issued Bulletin 113 on "Orchard Irrigation Studies in the Rogue River Valley." Unfortunately we do not have enough of these bulletins so that we can send them broadcast for general distribution. The bulletin is to be published, however, by some of the leading horticultural magazines and those interested will undoubtedly have an opportunity to secure an issue which contains the bulletin.

In a period of five years we have not found it possible to carry on all these lines of investigation, neither have

percentage of culls on the irrigated than on the non-irrigated soils. We were able, also, to reduce the percentage of windfalls. The saving at times amounted to as high as 15 per cent of the crop.

When the fruit trees are heavily loaded in the fall the strain on the tree is, of course, very heavy. If the tree does not receive the amount of moisture necessary to mature the crop, it immediately begins to shed its fruit heavily, and this loss at times becomes extremely great, the fruit beginning to drop a few weeks before picking time and continuing up to harvesting.

In one experiment which we conducted on a dark alluvial loam with Yellow Newtown trees 19 years of age, the first plot was given 600 gallons of water to each tree, in two applications, about the middle of July and the middle of August; the second plot 1,500 gallons to the tree the last of July and the latter part of August. The difference in favor of the greater irrigation was 5 per cent less culls and 15 per cent less windfalls. Had the owner been willing to have had an additional irrigation given in September we could have reduced quite materially the percentage of windfalls but the trees were so heavily loaded with fruit that we feared that with irrigating we would knock off many of the apples.

We have noted that the shape of the fruit can be materially changed by irrigation. The additional moisture gained has a tendency to cause the fruit to be more

angular and elongated. For several seasons this has been noted. Not only have I noticed this on the irrigated compared with non-irrigated land, but I have seen it illustrated on the plots that were well tilled compared with those that were in sod or received poor tillage. In an experiment that we have been running at our home station at Corvallis with Yellow Newtowns, those that were in sod when compared with the well-tilled fruit have given this difference. The Yellow Newtowns on the well tilled plot mature later, are more elongated, and are brighter in color. Those that received poor care and were allowed to stand in the grass matured earlier and had a deeper yellow at harvesting. This same tendency we found illustrated in the young trees compared with old ones, the elongation and angularity of the fruit being an indication of vigor.

Considerable influence has been noted as regards color. This is especially true on some of the lighter soils and where red apples are grown. Each year the irrigated apples have had a brighter, more attractive color, and are handsomer, while those on the dry checks were duller, yet deeper in color. The trade wants the bright, live, attractive apples. In a number of cases it was found that irrigation had an influence on the succeeding crop. The irrigated trees have more numerous and stronger fruit buds. This difference can often be noted at the blooming time. This was especially noticeable this last spring. The trees that had received more care and had had sufficient moisture bloomed more heavily than those which had not had as much moisture. Undoubtedly, under proper conditions, irrigation will have an influence in making the trees regular bearers.

Under conditions that are equal, we find that irrigation has a tendency to produce more wood growth. We have noted that this is true even though the trees are more heavily loaded with fruit. More wood growth is obtained from irrigation where the trees have not been vigorously winter pruned and are getting ample moisture. The difference between the dry check and a moderate amount of water is greater than between a moderate amount and an excessive amount. In one experiment the increase in terminal wood growth of the irrigated over the lighter or non-irrigated amounted to 12 inches, on an average.

As I have already said, there were less culls on the irrigated than the non-irrigated land, the latter suffering for moisture, was then referring to the size. We found, also, less culls due to calyx cracking on the irrigated than on the non-irrigated lands. Varieties like the Jonathan suffer greatly from calyx cracking. Cracking may occur at the stem, as well as at the calyx. In most cases this is due to the fact that the fruit hangs on the tree too long. We found the fruit on the dry checks matured earlier than on the irrigated plots. It showed that irrigation had a tendency to cause the apples to mature somewhat later, which meant that the irrigated fruit was in rather better condition at picking time, and we therefore had less cracking. Had the dry checks been picked earlier there would have been less cracking noted, probably, but it is sometimes almost impossible to so pick the fruit as to avoid cracking.

Irrigation tends to keep the leaves green later in the fall, and to cause them to hang much longer on the trees. In fact, if moisture is given the trees in the form of rainfall or irrigation so as to keep them in activity, we can expect the results noted. In certain seasons there is some danger of over-irrigation of young trees. This has a tendency to prevent the trees hardening. I have noted that the trees were sometimes more than a month later in maturing when heavily irrigated than otherwise.

I may cite a couple of experiments regarding foliage coloring on the plots. Plot 1 received 600 gallons of water to the tree in the middle of July, and again in the middle of August. Plot 2 had 1,500 gallons to the tree July 20 and August 25. On October 4 the foliage of the trees on Plot 1 began to color, and to drop from many of the trees. Plot 2 was still of a good, dark green color, and by November most of the trees on Plot 1 had shed a large per cent of their foliage, but though a few on Plot 2 had done likewise, the larger number had not. On most of the trees the foliage was just beginning to turn. The trees which had a light crop tended to color

earlier and drop their foliage earlier than those heavily loaded with fruit.

In a second experiment Plot 1 received 1,200 gallons of water to the tree August 14, Plot 2, 865 gallons to the tree July 27, Plot 3, 535 gallons to the tree July 27, and Plot 4 was a dry check. On the dry check the leaves began to fall and color by September 20, followed by plots 2 and 3, the foliage of these maturing about the same time. On Plot 1, where the trees received the heaviest irrigation, the foliage remained green later, and had not fallen late in November.

One advantage in irrigation we have noted is in its relation to the growing of cover crops. We found that on the irrigated plots, not only did the natural weeds grow, but the cover crops also made a much better growth than on the dry checks. This will be a very important factor in those orchards which are suffering because of a lack of organic matter and humus. Irrigation will aid materially in building up the humus content of such soils.

We have found that the irrigation practices in one district will vary and that such differences can be attributed to the kind of soil, variety of fruit, and age of the trees. Such problems as the determination of the exact time, to irrigate and the best methods to employ will vary with the conditions stated.

There is a great variety of soils on the Pacific slope. The problem of irrigating some of these is somewhat complicated. In some sections we have extremely heavy types, such as the stickies or adobes, and experiment shows that we generally get better results under cultivation without the use of irrigation water on such soils. They are exceedingly difficult to irrigate, and if irrigated, warm water should be used. Possibly the best way to handle such soils would be to grow shade crops and use the water for both trees and shade crops.

On the lighter types of soil more water is needed, especially where apples are grown. On the pumice soils, or very fine type of volcanic ash, we found in southern Oregon that at least 3,500 gallons of water to the tree is necessary, distributed in about three equal irrigations in June, July and August. We obtained the best results by allowing a small stream to flow down the furrow, increasing the amount to four inches to each furrow as soon as the soil began to take up the water. In some of the free soils in the Rogue River Valley we found that, where they were properly cultivated, they responded best with irrigation to the amount of 2,400 to 3,000 gallons to the tree, in two irrigations. This kind of soil is low in organic matter, takes water slowly, and to get an even distribution it is necessary to have a large number of furrows with a small amount of water in each.

With experiments with 10-year old Newtowns on river bottom soils, which vary from medium to slightly heavy texture, fine results were obtained by applying 1,600 to 2,000 gallons to the tree, divided in two irrigations, one in July and the other in August. This type of soil takes up water freely, and a comparatively large head to each furrow may be used.

On some of the lighter granitic soils it is better to use a number of furrows between each tree and its neighbor, with a small head of water. In nearly all cases furrows and rills are used, flooding having been practically abandoned in the northwest. In a few cases where the soil takes up water very slowly, however, if a sort of check or basis system is used it will prove to be one of the best systems.

From some experiments we have conducted with Bartlett pear trees 7 to 10 years of age, in good vigor, we found that the application of irrigation water seemed to have a tendency to make the trees more susceptible to disease, such trees blighting more readily. Under conditions where the pears were not making a normal growth it is better to add water regardless of the age.

The use of excessively cold water on pears is a questionable practice. Many heavy soils crack, and the cold water rushes down the cracks, interfering with the root functions. From observation we are led to believe the practice detrimental rather than beneficial.

Experiments with Winter Nelis, d'Anjou and Bartlett pear trees 18 years of age on a rather heavy type of soil have been made, the orchard being divided into several

(Continued on page 447.)

PLATFORM AND RESOLUTIONS OF 1912 IRRIGATION CONGRESS

We, the delegates to the twentieth International Irrigation Congress, assembled in Salt Lake City, state of Utah, extend cordial greetings to the irrigation host throughout our country and submit the following resolutions as a declaration of principles:

We hold that federal control as between the states is essential to the equitable distribution and utilization of the water of interstate streams.

We approve the development of navigation throughout the rivers and lakes of the United States in accordance with the most comprehensive plan.

Indorse Newlands Bill.

We renew our indorsement of the Newlands river regulation bill and urge its enactment by the federal congress during the coming session. This bill provides for the complete control of the flood waters of our rivers in such way as to promote irrigation and drainage, the development of power, the extension of navigation and the protection of the lowlands from destructive floods.

We heartily approve the federal forestry policy and favor its continuance and extension, and commend the co-operation of state and federal authority in the work of forest protection.

Name Needed Changes.

We recognize the establishment of the United States reclamation service, as second only in importance to the passing of the reclamation act, in the development of the arid west. Experience has demonstrated the expediency of certain administrative changes.

We believe the law should be so amended as to require that all contracts for the sale of power developed by, or in connection with, any reclamation project shall be approved by the project water users' associations under such project, having an interest in such contract.

Disposition of Profits.

We believe that the profits arising from the operation of any project should be covered into the reclamation fund to the credit of such project.

We favor the establishment of water users' associations under all government projects when 20 per cent of the land thereunder shall have passed into private ownership.

We recommend that complete plans and specifications of any work contemplated on any project should be delivered to the project water users' associations before such work is begun and that itemized semi-annual reports of all charges and expenditures under each reclamation project should be furnished to the officers of the water users' association under such project, and we favor the appointment of a consulting engineer under each project to be selected by and paid by the project water users' associations. Having access to the plans, specifications and accounts, but without supervisory power.

Land Geological Survey.

We commend the work of the United States Geological Survey and strongly recommend that more liberal appropriations be made by the federal legislatures of the states for co-operation in the prosecution of the topographical and water resources branches of this bureau.

We commend the irrigation and drainage investigations of experiment stations, the soil and water investigations of the bureau of soils and dry farming investigations of the United States Department of Agriculture, and equally commend the work of the agricultural experiment stations and engineering departments in the several states; we favor further investigation of natural sub-irrigation and of irrigation by pumping; and we urge more liberal appropriations by the federal congress and by the states for the work, and co-operation of these agencies, and for the more general distribution of the reports and bulletins recording their operations and results.

Believe in Carey.

We believe that the administration of the Carey act can be more effective by the establishment of effective state supervision for all projects undertaken in any such states.

We deprecate the sale of abandoned military posts for wholly inadequate prices, and recommend their transfer to the states in which they may be situated for use as agricultural schools, experiment stations or other uses.

We recommend that the congress of the United States rescind its action relative to the payment of expenses of government officers and employes in attending sessions of the Irrigation Congress, in so far as the same relates to experts, whose work bears a relation to the purposes of this congress.

Panama Canal Proposal.

Realizing that the opening of the Panama canal in 1914 will greatly increase the influx of immigrants, by permitting their landing on the Pacific, as well as the Atlantic coast, and that the greatest benefits of foreign immigration can be obtained only when the immigrants settle permanently on farms where they can quickly develop the spirit of citizenship, and help to render this a nation of homes, we recommend co-operation among the various state officers in the establishment of common agencies, including expositions and other means of diffusing accurate information, to the end that immigrants may be located on the land under conditions suitable to their habits, and conducive to the best development of the country.

Immigration Bureaus.

We also recommend to the legislative bodies and to the various commercial organizations, particularly of the states west of the Rocky mountains, the establishment and maintenance of bureaus at those Pacific coast ports, where the immigrants will land, and where accurate information concerning agricultural lands and conditions can be supplied to them.

We further recommend that the congress of the United States create a commission to investigate and report upon the colonization system now in vogue in other countries concerning rural settlement as well as the methods of co-operative farm loan systems.

Back Panama Fair.

Resolved, That the International Irrigation Congress co-operate to the fullest extent with the Panama-California Exposition in producing at San Diego, in 1915, the most elaborate and comprehensive international irrigation exhibit that has ever been assembled; that we invoke the aid of the legislators of the several states from the western part of the Union and of the governments of all foreign countries interested in irrigation to the end that this plan may be successfully consummated.

We invite the attention of the president and directors of the Panama-Pacific Exposition to the propriety of making provision for an adequate exhibit of irrigated farm products from the several irrigated states at the San Francisco exposition to be held in 1915.

The twentieth International Irrigation Congress proffers its sincere thanks to the state of Utah and to the City of Salt Lake, including the citizens and the Commercial Club and other organizations thereof, for the generous welcome and gracious hospitality extended to its members. The Irrigation Congress has felt at home in the city of its nativity. Its hearty thanks are tendered to Prof. J. J. McClellan and to Prof. Evan Stephens and to the tabernacle choir for the inspiring music which graced the opening sessions of the congress. Especial thanks are extended to the Western Union Telegraph Company for the unusual interest taken in advertising the congress throughout the United States and foreign countries and for special wire and messenger service afforded the congress. Cordial thanks are extended to the Saltair railroad for the pleasant excursion tendered to the members of the congress, and to the press of Salt Lake City for its interesting and complete reports of our proceedings.

Tribute to Foreigners.

The congress is to be congratulated upon the presence at this session of the accredited delegates from the united commonwealth of Australia, from the United States of Mexico, from the republic of Brazil, from the republic of Portugal, from the republic of Guatemala, from the provinces of Ottawa and Alberta, Dominion of Canada, and from British Columbia. We bespeak for future sessions of the congress addresses by eminent authorities on irrigation from these and other nations to the end that the congress may become the clearing house for the exchange of the most advanced ideas of all nations upon subjects pertaining to irrigation.

Taft Is Commended.

We commend our distinguished president, Senator Francis G. Newlands, for his inspiring leadership and his impartial conduct in the chair. We commend Mr. Arthur Hooker for his untiring services as secretary of the congress. The Utah board of control is entitled to the thanks of all for the splendid success which has attended its preparations for the twentieth Irrigation Congress.

Resolved, That the earnest thanks and appreciation of this, the twentieth International Irrigation Congress be extended to the Honorable William H. Taft, President of the United States, to Governor Woodrow Wilson and to Honorable Theodore Roosevelt for their cordial and encouraging messages expressive of a sympathetic interest in the objects and purposes for which this congress has been established and perpetuated.

Will Advocate Laws.

Resolved, That the board of governors of the twenty-first International Irrigation Congress be and is hereby directed to appoint and empower a committee for the purpose of appearing before both houses of the congress of the United States for the purpose of advocating the Newlands river regulation bill, and such other measures as have received the formal indorsement of this congress.

IRRIGATION AND THE GARDEN.

By Prof. W. J. Elliott,
Superintendent of Agriculture, Department Natural
Resources, C. P. R.

Irrigation to many localities is a veritable boon, and yet irrigation may have its harmful as well as its beneficial influences, when handled carelessly or when handled by one who does not understand its use.

A month or two ago I saw a man irrigating his garden, and he had run so much water on to the soil that he sank to his knees as he puddled around to direct the water with his shovel. That was not irrigation; it was folly. He was evidently going upon the theory that if a little water was good a lot was better. The result was

vegetable is not properly matured, and, hence, has not the market value.

Irrigation is common sense; we might ask ourselves what is proper irrigation, and the reply might be, the application of water artificially, and where necessary, in such quantities as to produce a fair yield of properly matured produce. So that proper irrigation comes to be the common sense application of water to growing plants. The point is not how much water can I use, but how little can I use to attain the desired results. And right here is where we find a great difficulty with many water users. If the water is in the ditch, they cannot bear to see it going past, but will run it on the land, with little regard for the amount necessary.

A point, all competent irrigators agree upon, is that one should rather under irrigate than over irrigate.

How Much Water to Apply.

There is no fixed rule for the application of water to any crop. One locality may demand a certain amount, while another locality may require an entirely different



STRAWBERRIES IN THE TWIN FALLS COUNTRY, IDAHO.

The Berry Season Just Closed Has Shown Conclusively that These Irrigated Berries May be Shipped with Liberal Profit to the Grower to Eastern and Southern Cities, Beginning With the Close of the Season for Southern Berries.

disastrous, for the heavy flooding of his land was having four very serious evil effects upon the growth of his crops:

1. He was lowering the temperature of the soil and hence retarding the growth.
2. He was excluding air, which is an absolutely essential requisite to plant growth.
3. The lowering of temperature and excluding of air has a serious effect in lessening the production of soluble plant food.
4. The combination of these above points hinders ripening, frequently to such an extent that the grain or

amount. This amount is influenced largely by three things.

1. The amount of evaporation.
2. The character of the soil.
3. The character of the produce grown.

For instance, the northern part of Alberta, about Edmonton, gets about the same rainfall as certain areas in Texas, and where the Edmonton district requires no irrigation, Texas requires a great deal. The main reason for this is the excessive evaporation due to the intense heat. A heavy rain may fall and, in a short time, the soil may be as dry as ever, and all due to evaporation.

The character of the surface and sub-soils also plays an important part in that evaporation is aided or retarded by its sandy, clay or gravel character.

Thus the amount of evaporation and the character of the surface and sub-soils will influence us very materially in the amount of water we should apply. The character of the crop also has its influence, but this will be discussed more particularly when we discuss the various garden crops.

When Do We Require Irrigation?

Here again no hard and fast rule can be given. Some one has unofficially stated that for districts similar to Montana, British Columbia, Alberta, etc., irrigation may be deemed advisable, where the average precipitation falls below 20 inches. This has come to be somewhat generally accepted, although it does not mean that paying crops may not be grown, under certain conditions, with less than 20 inches of water, nor does it mean that considerable advantages may not be added when the annual precipitation is considerably above 20 inches. The other conditions, mentioned above, need to be taken into account also. However, the division between dry and irrigated areas may be placed, with a certain degree of safety, at about 20 inches of precipitation.

This fact is also true, that in districts where the precipitation is about 20 inches, there is scarcely a year, even among the wettest years, where some of the many crops grown upon the ordinary farms may not be greatly benefited by a judicious application of water. We can all remember, almost in any district, where a few weeks of drouth would come and where the owners of crops would give almost anything for the possibility of applying irrigation water. This may be true in areas where there is considerably above 20 inches. Then, much more true is it in areas where the average annual precipitation is in the neighborhood of 20 inches or below this point?

In the Strathmore district the average precipitation covering a number of years is 15 to 17 inches. During 1911 we had an abnormally wet year, with a precipitation of something over 20 inches, and, even in that year, in the fore part of June, when it was extremely hot and dry, alfalfa was greatly benefited by a good application of water.

If this is true with general grain and fodder crops, how much more so is it with the garden crops? Vegetables and fruits are very largely composed of water, and, consequently, the production of large yields will come as the result of the ability to apply, either naturally or artificially, considerable quantities of water.

We will now submit a list of the garden crops grown in the Strathmore vicinity, with the time of irrigation, and also some of the advantages of the artificially applied water.

Small Fruits.

Among the small fruits we grow very successfully, the red, white and black currants and all varieties of gooseberries. With these plants irrigation water is applied first from the middle to the end of May. This induces the plants to throw out a large amount of fruit bloom and then after the fruit is set a judicious application of water induces the production of a large crop of luscious berries.

Strawberries.

With strawberries we have found one application to be desirable and sufficient. With this fruit we have had considerable success. By covering the plants 2 or 3 inches deep with well-rotted horse manure and leaving this covering on until about the end of May we control almost perfectly, the time when our fruit will be ready for market.

In Calgary we get B. C. strawberries during the early summer months. But in Alberta by somewhat controlling the maturing of the fruit, with the manure mulch, our berries come onto the market from July 15th to the 20th of August. Thus, they are brought onto the market at a time when there is not a competing strawberry between Vancouver and Winnipeg, and at a time when the first imported fruits, on our market, are rather high in price.

The irrigation water is applied just as the first bloom appears. This induces a heavy fruiting and gives the plant

sufficient moisture to last through July, when we frequently have warm, dry weather. By this method the plant has a sufficiency of moisture to mature the entire crop without having the last berries dwindle down to small size, as is frequently the case in dry weather. We find one irrigation sufficient, unless extremely dry weather is experienced, and have discontinued the irrigation during the fruit producing time, on account of the fact that the berries are apt to grow too rapidly and thus, because they are so soft, ship in poor condition. One thorough irrigation has produced a fruit season of almost six weeks and has produced with us almost \$500 as a gross return per acre.

Potatoes.

With potatoes we have not always had the best results with irrigation. We can produce a very large tonnage, but not the quality. Heavy irrigation of potatoes produces a soggy potato that is a poor baker. We obtain our best results by planting our potatoes on ground that has been used for peas, rape or garden truck, and that has had a good irrigation the year previous. It appears that a sufficiency of moisture is carried in the sub-soil to give us plenty for potatoes. We work particularly for quality with this crop and not so much for quantity.

Rhubarb Pie Plant.

Here again we have done remarkably well with this crop. It is a fact that we have planted the seed in August, then after the plants were up two or three inches, they were given a light irrigation. The plants were transplanted the next spring, irrigated in June and in July, exactly eleven months from the time the seed was placed in the ground, we were cutting the plant for market. Those who have grown rhubarb know that it generally takes two years to grow this plant successfully from seed.

Other Vegetables.

For the balance of the vegetables, generally, we have found irrigation to produce splendid results.

These would include beets, carrots, turnips, beans, radish, parsnips, cabbage, cauliflower, peas, spinach, etc.

We have found that irrigation produces a much larger tonnage and as this does not hurt the quality, as may be done with potatoes, there is this decided advantage. Cabbages and carrots may require slightly more care than the balance of the common vegetables, as a plentiful supply of water during a hot, rapidly growing period may cause the carrots to crack or split down the side and the cabbages to burst.

Green peas and spinach will take a plentiful supply of water and particularly with the peas the continuance of the moisture supply will induce a long period of flowering and consequently a large crop.

With irrigation second and third crops of such things as summer turnips, peas, radish, spinach, etc., may be set out, a thing that is not so possible under ordinary conditions as, of necessity, these would have to be sown during hot dry weather, when it would be difficult to have seeds sprout or come to any value after sprouting.

A simple irrigation of the ground before these second and third crops are sown, insures rapid germination, quick growth and additional profits.

There are many other phases of the irrigation of the garden that might be touched upon, but those given above will suffice to show the great benefit of irrigation in the production of garden produce.

A WORD OF PRAISE.

MUROC, CAL., September 21, 1912.

IRRIGATION AGE, Chicago, Ill.

Gentlemen: Please pardon my delay in acknowledging receipt of "Primer of Irrigation" as premium with AGE.

It is a veritable agricultural college in miniature and well worth the subscription price of IRRIGATION AGE, while the latter contains helpful articles, each one of which is worth the price of the magazine many times over.

Yours very truly,

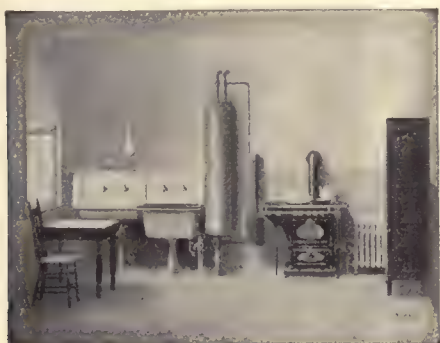
(Signed) P. C. HONIGH.

WATER SUPPLY SYSTEMS IN THE FARM AND HOME

By Mr. S. E. Brown.*

One of the causes of dissatisfaction with farm life as found by the commission appointed by Mr. Roosevelt when president, was the lack of conveniences in the home. It must be admitted that when compared with the conveniences found in the average city dwelling, the farm home even of the well-to-do farmer shows badly. Labor saving devices have been purchased for farm use to a very great extent. The money invested for conveniences for the home, however, is comparatively small. Fortunately this state of affairs is changing and while a few years ago one would possibly have found a sewing machine, washing machine, bread mixer and perhaps a few other articles whose use lightened the labors of the housewife, it is now not uncommon to find in addition to the above mentioned articles, water systems, heating systems, lighting plants, refrigerators, vacuum cleaners, fireless cookers, etc.

There can scarcely be any dissention to the statement that of all the above mentioned items, the water system stands first in its importance to family comfort and welfare. The farmhouse with a pressure water sys-



Kitchen.

tem has all the advantages and sanitary conveniences of the city home. A modern bathroom, kitchen, sink, hot water tank, running water in the laundry, dairy and barn are comforts and conveniences of far greater value to the farmer than the small cost they represent.

One great virtue of a pressure water system is that it makes a modern bathroom possible. From a hygienic standpoint the bathroom is an absolute necessity. The conditions under which the average family on the farm lived until recently would not be tolerated by a city family. Of course one can have baths regardless of whether there is a water pressure system or not. But the plain fact is that bathing is neglected when it means the carrying of water from well or cistern, heating it on the stove and securing after all this effort a rather unsatisfactory bath. When a man comes in from the field after a hard day's toil, his body reeking with perspiration, dusty, tired, exhausted, nothing is more refreshing and conducive to a good night's rest than a pleasant, agreeable bath. It will be taken, too when the only effort required is to turn on the water.

When the element of conveniences is considered it is surprising that the farmer has so long permitted himself—and especially the women of his household—to worry along with the endless toil of water pumping and carrying. It is the wife and daughters that usually suffer most. Not only must water be carried for ordinary domestic

purposes but on wash days when the work should be lightened it is increased by the labor necessary to carry tubful after tubful from cistern or well, frequently in inclement weather when the risks from exposure are great. Contrast this with running water both hot and cold always on tap! The sum that would be invested in a new implement to lessen the work on the farm should surely not be considered exorbitant to expend for equipment that will put an end to all this needless drudgery.

Water systems as now offered for private installation



Bathroom.

give ample opportunity for one to secure apparatus that is dependable and that can be secured for a reasonable outlay. One of the most popular types marketed is known as the Fresh Water System, so called because with it water is delivered "fresh" from the well to the faucet. This system will always have preference where convenience and flexibility are given first consideration. It is, in fact, the most modern method of water delivery under pressure and gives service fully equal to and in most cases surpassing that available in the city. For instance, it is not at all infrequent to find these systems supplying water from well or spring for drinking purposes; from a cistern for domestic use, and from one or more additional wells for stock and general purpose use, and all operated by only one power plant. This Fresh Water System is available when the water does not have to be elevated more than 100 feet and where the water is clean, free from sand, grit and other impurities.

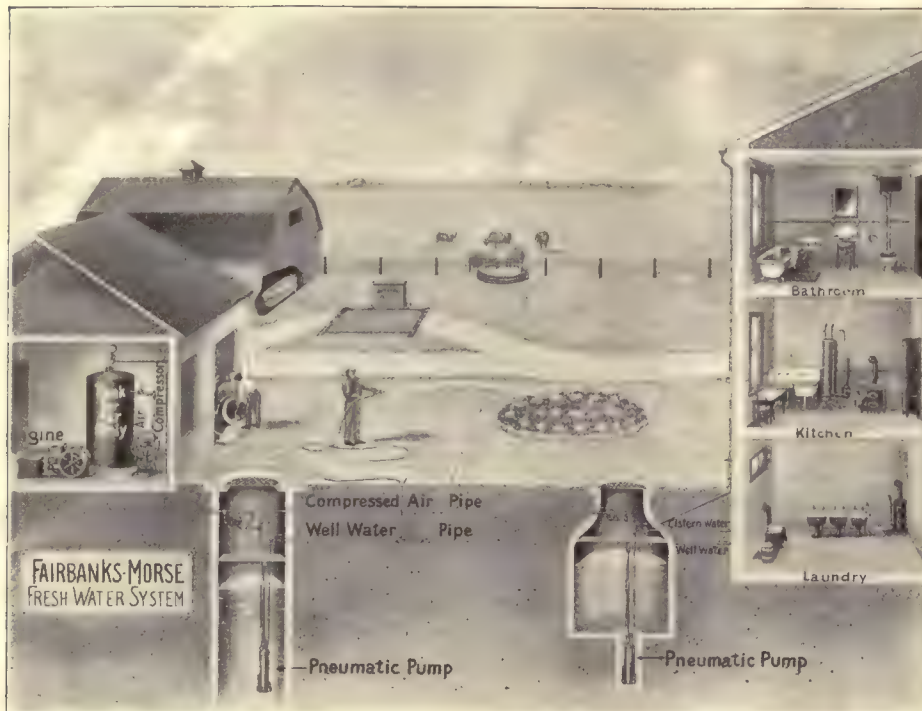
These plants consists of an air compressor which may be driven by a small gasoline engine or electric motor, an air-tight steel tank for air storage and an auto-pneumatic pump for each source of water supply. These pumps consist of two small metallic chambers which are



Laundry.

submerged in the water. When a faucet is opened they automatically fill and discharge due to the compressed air pressure from the storage tank, thus giving a continuous flow of water. In addition to the strong feature of water being delivered fresh and cool an advantage of this system is that since compressed air can be piped most any distance to the auto-pneumatic pump in the well without any

*Courtesy of Fairbanks, Morse & Co.



Fresh water system, operated by gasoline engine or electric motor. The compressor forces air into the storage tank until a pressure of about 90 pounds is obtained. Ordinarily this will supply water for several days' use.

appreciable loss, the power plant, and air storage tank can be located wherever convenient, as in barn, garage or dry basement. This makes it an easy matter where an engine is used, to arrange to have it drive other machinery when not in use for pumping water.

For the benefit of our readers who may be interested to know something of the engineering problem in connection with water systems, we give below a table showing the amount of water, in gallons, that can be drawn from faucets by auto-pneumatic pumps at various working pressures by the expansion of compressed air from a 1,000 gallon air tank. To make this table of greater value an estimate of the amount of water used for various purposes on the farm is also given:

PUMPING CAPACITY OF AIR TANKS.

Working Pressure on Pump Gauge	40 lbs.	50 lbs.	60 lbs.	70 lbs.	80 lbs.	90 lbs.	100 lbs.
25 lbs.	375.	595.	833.	1075.	1310.	1548.	1786.
30 lbs.	221.	442.	663.	884.	1105.	1326.	1548.
35 lbs.	102.	306.	510.	714.	924.	1123.	1327.
40 lbs.	....	187.	374.	561.	748.	936.	1123.
45 lbs.	....	85.	255.	425.	596.	765.	936.
50 lbs.	....	....	153.	306.	460.	612.	765.
55 lbs.	....	....	68.	204.	330.	476.	612.
60 lbs.	....	....	....	119.	237.	375.	476.
65 lbs.	....	....	....	51.	153.	255.	357.

For air tanks of other than 1,000 gallons capacity, divide the above figures by 1,000 (more decimal point three places to the left), and multiply result by number of gallons the tank holds.

Note: It takes .43 pounds pressure per square inch for every foot that water is forced upward in standpipe or elevated tank. For instance, if water is forced 20 feet high, $20 \times .43 = 8.6$ pounds pressure per square inch is secured; 40 feet high gives 17.3 pounds pressure; 60 feet high, 25.8 pounds pressure.

Reversing the foregoing proposition, every pound pressure per square inch in a service pipe elevates water 2.31 feet high. If there are 15 pounds pressure per square inch in the service pipe, the water will be elevated

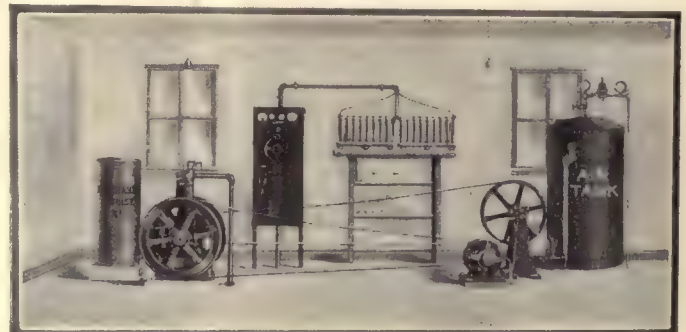
$2.31 \times 15 = 34.65$ feet high; 25 pounds pressure elevates water 57.75 feet high; 35 pounds, 80.85 feet high, etc.

Amount of Water Required for Stock and Other Purposes.

Horses drink 5 to 10 gallons per day. Cattle drink 7 to 12 gallons per day. Hogs drink 2 to $2\frac{1}{2}$ gallons per day. Sheep drink 1 to 2 gallons per day. With 40 to 50 pounds pressure per square inch, an ordinary $\frac{3}{4}$ -inch garden hose nozzle requires about 6 gallons per minute, when throwing a solid stream, or about 4 gallons when spraying. It requires about 8 gallons to sprinkle 100 square feet of lawn; 16 to 20 gallons will soak it thoroughly. It required about $1\frac{1}{2}$ gallons to fill an ordinary lavatory; 30 gallons to fill the average bath tub. It requires about 7 to 10 gallons to flush a closet. 300 gallons is a fair estimate of the amount of water required by the average sized family in 24 hours.

Only power driven outfits should be considered where any considerable amount of water is to be used. In this connection it may be stated that the amount of water used for general purposes will be greatly increased when the water supply system is put in service. This does not imply that a family will be extravagant in the use of water merely because it is easily obtained. It means that all too small an amount is used where the family depends on other methods. In addition to a plentiful use of water for domestic use and for proper stock watering it is obvious that much will, if available, be used for other needs. Thus the garden will not be allowed to perish in case of drought nor will lawns and flower beds be permitted to die down in the summer.

Where one desires to draw water from a single well, or from a well or cistern the pneumatic tank method is



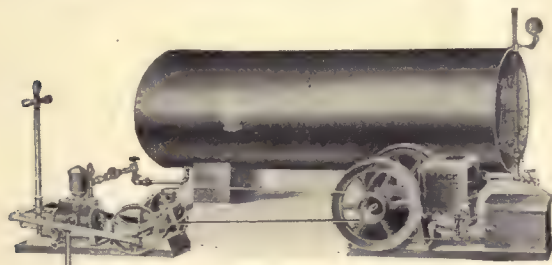
Combined Water and Electric Light System.

frequently used. In this case water is pumped into an air-tight tank the compressive force on the air serving to force the water to the taps.

Regardless of the system selected, a hand operated outfit should not be considered unless the water to be used is confined to purely domestic purposes. A considerable amount of physical energy is required to get a supply of water stored under a pressure of from 60 to 70 pounds. As fire protection is one of the great features in favor of water pressure systems it will readily be seen that low pressure outfits are not advisable. Where water

from cistern for bathroom, sink, etc., is all that is to be pumped, a hand outfit may be found satisfactory. It is not at all fitted for service where stock watering, lawn sprinkling, carriage washing and similar purposes are to be served.

The plan of a new house should invariably incorporate a water system even though the installation of the system is not to be made immediately. In the same way in the selection of a kitchen range or furnace it should be seen to that the firebox has pipes for water heating or at



1-Horsepower Outfit Combined Hand and Power Pneumatic Tank System. Where a small amount of water is used one of these hand operated outfits will be found quite satisfactory. Where a large amount of water is to be used, power should be used for pumping.

least so arranged that these may easily be put in place. Heating from the range is in a measure more satisfactory than from a furnace as the range is more likely to be used the year round. Plans for the barn should also be made with a view to having water brought into the building in inclement weather makes caring for stock a hard-



The Eclipse is always artistic. Many farm homes utilize the windmill to secure a water pressure system. The above shows an especially attractive installation of this kind.

ship. This is especially true during the severe weather of winter. With a water pressure system it becomes an easy matter to fit up a tank in all buildings where animals are kept so that stock can be watered without exposure.

THE IRRIGATION OF ALFALFA.

By Alfred Atkinson,
Montana Agricultural Experiment Station.

Under favorable growth conditions, alfalfa, with its strong, widely spreading root system, is able to get food for vigorous development. Favorable growth conditions include proper temperature, good aeration and adequate moisture supply. In the almost ideal climate of Western Canada very profitable yields of this crop ought to be produced if the supply of moisture is regulated. The acreage given over to the production of alfalfa is constantly increasing. The question of the proper irrigation of the crop is an important one.

On account of the differences in the amount and distribution of the rainfall, as well as of other influencing factors, the details of irrigation practice will, of necessity, vary with the different localities. In some sections of the western United States a winter precipitation with a dry summer makes heavier irrigation demands than are found in sections having greater rainfall during the growing months. Attention is directed to these facts to avoid too close imitation of the practices discussed, when such practices are not best. The hope is to bring out principles involved and to refer to some of the important features of the irrigation practice, with which the writer is familiar. Out of the experience which comes from years of practical irrigation will come the details for the "best" system for western Canada.

For a permanent crop like alfalfa, it is important to have the irrigation in mind before any planting is done. Properly levelled fields irrigate more easily, and with much greater economy than do those having slight irregularities over the surface. The first step in alfalfa irrigation is to make a compact and carefully levelled seed bed.

The land ought to be plowed a sufficient time before seeding to allow the surface to settle. Where alfalfa is to be spring planted, fall plowing is wise. In sections where alfalfa does not start readily, summer farrowing or summer tilling the land the season previous sometimes brings good results. In preparing the seed bed all dead furrows should be disked in and the field should be crossed several times with a leveller. The levelling should be done the same way as the field was plowed, the cross-wise of the plowing, and again across from corner to corner. If these three levellings do not remove the unevennesses, the field should be crossed again. This may appear like a lot of work; but when we remember that the crop will be down for a number of years, it is apparent that a little extra labor in preparation is a wise investment.

Many kinds of levellers are in use and effectiveness is not wholly confined to any one. A leveller that is favorably spoken of is made as follows: Take two 2x10s, 16 feet long, and fasten them together strongly with three 2x10s, 8 feet long. These three cross pieces are to be placed one close to the front, one near the rear, and the third in the center. The front and back cross pieces are to be slanted slightly so that they will not present a firm cutting surface. The center cross piece ought to be strongly braced in an upright position and fitted with a metal cutting edge. This edge shaves off the irregularities. The advantage in having the leveller long is apparent. It is used to smooth the surface and, like a smoothing plane, is best when long. This implement will level a strip eight feet wide each time across the field. When it is carrying reasonable weight, four average horses will handle it without inconvenience. Good levelling cannot be too strongly emphasized.

Many alfalfa growers have found it wise to put in the ditches before the planting is done. The advantage in this lies in the fact that plants may be kept from growing in the ditches and interfering with the flow of the irrigation water. The only precaution needed is to see that no seed falls in the bottom of the ditches.

The location and distance apart of the ditches must be determined for each particular field. After a little experience, a practical irrigator is able to locate the necessary lateral ditches. For the main head or supply ditches

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it is best to have these located by an engineer or some one of experience in this work. Some of the common mistakes in putting in lateral ditches are to put them on a grade that is too steep, and to put them too far apart. Ordinarily, lateral or distribution ditches ought to be placed from fifty to sixty feet apart, and the fall should not greatly exceed one inch to the rod. In the case of a field with a definite side hill slope, the laterals should run around the side of the hill. Laterals are commonly put in with a double mold board plow. When the fall will permit, it is obviously best to make them straight. This makes for ease in cutting and handling the crop. The machinery does not strike the ditches at different angles. However, this advantage is not sufficient to offset the serious disadvantages from the washing of the ditches and the improper distribution of the water where ditches are on a grade that is too steep.

In order that the water may be turned out of the ditches at the proper places, diversion dams are put in every sixteen to twenty feet. When the ditches are freshly made, these dams may be of dirt gathered in the bottom of the ditch. After the alfalfa becomes well established, dirt dams are not practicable and manure dams are generally used. These dams consist of piles of manure in the bottom of the ditches, and this is spread over the field as the dams are removed during irrigation. In some sections canvas and metal dams are used. The canvas dam is made by attaching heavy-weight canvas to a cross piece which is wide enough to go across the ditch. The canvas is long enough so that it lies along the bottom of the ditch for six or eight feet, and is held down by a few shovelfuls of dirt thrown on it. This form of dam makes for a relatively small amount of shovelling, and seems to be gaining in popular favor. Metal dams are usually made of galvanized iron and shaped so that they fit the bottom of the ditch to a certain extent. A strong central stake is provided and the dam is driven down into the ditch.

Turning from a consideration of the preparation to the actual irrigation, two questions stand out as of chief importance. These are: When should alfalfa be irrigated, and how much water ought to be used? As to the proper time, of irrigation, the common practice includes irrigation before the first crop is cut, or irrigation for the first time after the first cutting of hay has been removed from the field. Where there is a fair amount of rainfall during the early summer, and where there are apt to be showers while the first crop is curing, it is usually best to add no irrigation water until this crop has been removed from the field. The irrigation can then be given quickly to start the second crop. Where springs are dry, and especially where good curing weather may be depended on at haying time, it insures a prompt start in the second crop if the field is irrigated ten days or two weeks before it is ready for the first cutting. After the second crop has been removed, the field is again irrigated. In localities where four crops are harvested, irrigation is again necessary after the third crop. At the higher altitudes and under other conditions where curing is slow in the field, no fourth crop is cut, but instead the fields are pastured. In this case irrigation is not practiced after the third cutting.

The question of the amount of water to use merits careful consideration. It might safely be said that in the majority of cases irrigation farmers are using much more water than is necessary. The truth of this is shown by the increase in acres ruined by alkali, and by the swampy condition which is noted on the lower lands in irrigated sections.

If we compare the natural precipitation of irrigated areas with that of humid sections where no irrigation is practiced, we will find that the difference does not exceed ten to fifteen inches a year on the average. In many humid localities the crops would be benefited by a little more rainfall, so we must naturally expect to more than make up this difference. If water equivalent to fifteen or twenty inches should be added at the proper time, it ought to fully supply the amount needed for the growth of the crop. A study of the duty of water or of the amount of water which is being used from many of the streams in the State of Montana shows that the amount taken out during the irrigation season is sufficient to cover the irrigated

(Continued on page 441.)

THE MANUFACTURE OF INDIA RUBBER.

By Dr. Leonard Keene Hirshberg, A. B., M. D. (Johns Hopkins.)

In a historical volume written at Madrid in 1601, describing the discovery of America by the Spaniard of Castile in 1492 and the following year one, Antonio de Herrera Y Tordesillas, mentions the fact that the Haytians played a ball game with gun balls. This is the first example in literature of any suggestion of India rubber. This same writer describes the Mexicans as making slits in trees to permit the flow of a pleasant smelling, milky gum. Juan de Forquemandia, in his book: "The Indian Konarchy," published in 1615, described those trees accurately as rubber trees, and states that the Indians used this "elastic" gum for medicine and the Spaniards used it for "waterproof cloaks."

Lacondamine sent some of the dark gummy caoutchouc from Brazil to the Paris Academy in 1736. The Indians had long known its waterproofing powers, and called the gum of the Hevea tree "Cahucha." Fusset Aublet, a French botanist, discovered the same tree in 1762 in French Guiana, while three years later M. Coffigny found it in the Island of Madagascar.

Chemists sought with great difficulty some sort of solvent for this, but not until 1761 was it accomplished. Herissant and Macquer then dissolved caoutchouc in oil of turpentine, rectified over lime, and obtained a mass that allowed the rubber to regain its elastic state. Ether was also used.

Priestley, the great discoverer of oxygen, in 1770 found that rubber made a good eraser for pencil marks. Magellan then—two years afterward—incited the French to use rubber commercially and its price was \$5.00 an ounce.

In 1798 Mr. J. Howison discovered a rubber tree (*Urceola elastica*) in Penang province and Dr. Roxburgh announced another tree (*ficus elastica*) in Assam province.

Samuel Peal in 1791 had already taken out the first patent in connection with rubber "for the application of dissolved rubber to waterproofing." Twenty-nine years later a second equally useless patent was obtained by Thomas Hancock, April 29, 1820. In 1823 Charles Macintosh received the patent on waterproofing fabrics by dissolving rubber in coal oil and built the first factory in Glasgow, removed later to Manchester. This firm, C. Mackintosh & Co., had Messrs. Birley as partners. The third and fourth generations of the Birleys are still managing this, the largest factory making raincoats, in the world.

Until 1823 rubber was imported in the shape of figures and bottles. No uniformity in thickness was possible. True, Hancock had, in 1826, made a hand-machine to macerate the rubber, but this machine could only squeeze one pound at a time.

In 1827 Hancock moved into a larger house in Goswell Road. Here a horsepower mill, using large iron rollers, macerated the rubber while raw and hot. A rough, corrugated sheet of rubber emerged from the rollers and dried very easily. The only difference between the rollers in use today and those used in 1826, is the size. The sheets then weighed about fifteen pounds. Now they weighed more. Garters, bracers, knee caps, bandages and suspenders were all made by Hancock. As early as 1823 he made billiard table cushions and in 1826 was manufacturing driving belts. He gave MacIntosh royalties for the use of his patent.

Hancock made air beds, cushions, life preservers, diving suits and started a branch factory in 1828 in Paris. In 1830 he merged with Mackintosh & Co., but maintained separate factories.

The fact that all articles made then would not stand the stress of heat and cold lead a German chemist, Professor Ludersdorf, in 1832 to the discovery that sulphur mixed with rubber dissolved in turpentine removed all viscosity from the rubber. Here he stopped.

Then in 1839 Nelson Goodyear, an American, solved the riddle of the rubber question. He discovered how to produce rubber objects that would withstand all extremes of cold and heat. Nathan Haysard, his friend and partner, one day accidentally dropped some rubber mixed with sulphur upon a heated stove. When he picked it up it was noticed that the sulphur was absorbed by the rubber,

which kept its elasticity when afterwards exposed to the hot sun. Goodyear, who had three years before started in the rubber business by getting United States Government contracts for rubber mail bags, continued experimenting with this discovery and in 1844 received his patents on the vulcanizing process.

Hancock had also allowed little grass to grow under him, for in 1843 he had garnered a British patent for the same method, and thus prevented the Haywood Rubber Company from sending rubber shoes into England several years later by claiming infringements on the English patents. Finally, however, this was withdrawn and the American firm was granted the right of selling the American style of overshoes in the Islands.

That heat was superfluous for vulcanization was proved publicly when in 1846 Alexander Parkes obtained a patent for a vulcanizing method, consisting of dipping the rubber into a solution of sulphur and carbon bisulphide.

THE ENGLISH WALNUT.

Its Culture in the United States Developed Into Paying Crop.

Owners of country estates and orchardists throughout the United States are just now devoting more attention to the culture of the English or Persian walnut than to any other industry. In fact, horticulturalists everywhere are tremendously interested in the propagation of this delicious fruit, both from a commercial and an aesthetic point of view.

For many years the English walnut has been cultivated with more than ordinary success in California, but only very recently has a sufficiently hardy variety been found to withstand the severe winters of the northern, eastern and southeastern states. The circumstances pertaining to the discovery of an unusually hardy variety, the Pomeroy English walnut, may be related as follows:

The late Norman Pomeroy of Lockport, N. Y., while attending the Centennial exposition in Philadelphia in



ONE OF THE FORTY-ACRE FARMERS, TWIN FALLS, COUNTRY.
Apple Orchard and Strawberry Field Belonging to Herman Riek, Formerly of Rosalia, Wash., Near Jerome, Idaho.

Leather was giving steadily away to rubber. Door springs, mail bags, printing cylinders, belts and similar objects, formerly made of leather, was being manufactured of rubber. In 1850 Halkett of the English navy, invented the rubber collapsible boat. In 1886 patents doing away with the smell of rubber and patterns in rubber fabrics, stimulated the adoption of raincoats, blankets and fashionable uses for ladies' rubber cloths.

Then came the patent tires of Michelin and Dunlop and others for bicycles, electric wires, automobiles, and innumerable other things. In 1910 for the first time in history there was a shortage in the natural supply of rubber. Para rubber jumped in one year and a half from fifty cents to two dollars and seventy-five cents a pound. Yet in that year America exported nearly 40,000 tons of rubber. In 1830 America exported only twenty-five tons.

Last year the synthetic manufacture of laboratory rubber began. Like plantation rubber, it is just as good, if not better, than old Para rubber. Synthetic rubber is built upon a chemical compound called isoprene. It has not yet arrived at a commercial basis.

1876, noticed a species of tree totally new to him. On investigation, he found it to be an English walnut tree of surprising beauty. It was the fall of the year and the ground underneath the tree was covered with nuts. These proved to be equal, if not superior, to the taste, to any of the imported varieties with which Mr. Pomeroy was familiar.

Being thoroughly versed in arbor culture, Mr. Pomeroy propagated young trees from this acclimated variety, feeling certain that from these he would ultimately obtain an English walnut of superior hardiness, capable of resisting the rigors of almost any climate.

He planted these young trees about his residence in Niagara County, N. Y., in the spring of 1877 and they grew steadily, making surprising growths each year until now they stand fully 50 feet high, with a spread to their branches of 40 to 45 feet, and yielding nuts of the finest quality and in great abundance. During the 35 years of growth where the temperature has frequently decended far below zero, they have not had a single setback, maturing even earlier than the black walnut or the oak.

The elder Pomeroy's remarkable success has attracted the attention of nut culturists, horticulturists and progressive farmers in all parts of this country and Europe. Nut specialists from California came east and examined the Pomeroy trees, and were well satisfied that a hardy variety for the colder states had at last been found.

Realizing the value of his father's discovery, Mr. E. C. Pomeroy, a few years ago, set out several orchards of the variety which had thriven so well, and all these trees are now in a fine state of healthy growth, and are known by nut growers all over the country. Only the other day a prominent physician in Atlantic City, just returned from a tour of Austria, told Mr. Pomeroy of the fame which his orchards enjoyed abroad. As an instance of this, the doctor mentioned the name of an Austrian nut grower, who declared the Pomeroy nut to be the very best variety in the world. These nuts do not become rancid in warm weather, having been kept for several years in perfect condition, without cold storage.

So profitable has the culture of the English walnut in the eastern and northern states become, that owners of farms and suburban tracts are beginning to set out large orchards, in preparation for the immense demand that is already being shown for this most edible of all nuts.

It is only a few years ago that the cultivation of the English walnuts for the market started in California, and today they are shipped from that state in car and train loads. To show, however, that the supply does not begin to meet the demand in this country, it may be stated that the United States consumes more than 50,000,000 pounds of English walnuts a year, and that about 27,000,000 pounds of these have to be imported every year. And when it is known that the price is steadily advancing, it will very readily be seen that the possibilities of commercial success are unusually great.

In California the nut industry is rivaling that of the orange, and even now there are more dollars worth of nuts shipped from the state per year than there are of oranges. This statement is meant to include all varieties of nuts, although the English walnut figures largest in the proportion.

As to planting and cultivating English walnut trees seem to require no particular soil, but should not be set out where it is low and wet. The trees should be planted forty to fifty feet apart each way. A cultivated crop, such as corn or potatoes, with small fruit trees for fillers, can be made to yield an income for the brief period, comparatively, before the walnuts begin to bear. The pruning should be done between fall and spring, only such branches as would interfere with cultivation being removed.

In planting on the lawn the ground about the base of the tree should be kept spaded for three feet in circumference, and after the first year some well-rotted manure should be worked into the soil around the tree. No cultivating should be done after the first of August, as it would encourage further growth and from then until winter the annual growth of wood is ripening and hardening.

No more beautiful shade tree is known than the English walnut. They make comparatively no litter, have a pure white bark, very closely resembling that of the white birch, and bear a heavy foliage with a rich, glossy leaf. They are almost immune from insect pests, a certain alkali sap which they possess serving to drive away the parasites which are so ruinous to the chestnut and nearly all other fruit trees.

In the English walnut at its best the male and female blossoms mature at the same time, insuring perfect fertilization. Under favorable circumstances the trees will bear nuts three to five years from transplanting and increase in yield yearly. As a food-nuts are becoming less a luxury and more a staple article of diet. Their value is being recognized and they are being used more and more as a substitute for meat, one pound of walnut meat being said to equal eight pounds of steak in nutriment.

In transplantation most growers have found that two to four-year-old trees are most readily transplanted. At this age most of their growth has been in roots and removal causes them to throw out additional roots and

thus give increased vigor to the tree. Then again the smaller the tree the more safely may it be packed and shipped to its destination.

The eastern grower has many advantages over his rival of the west. First of all, there is the consideration of freight charges, which on a carload from California amounts to such a sum that, added to the cost of the nut, naturally increases the price per pound several cents over the variety grown in the east and placed in an eastern market.

A California grower of English walnuts who recently visited an orchard in western New York declared the specimens which he saw there to be "the very finest I have ever seen." "You have a better flavored nut and you have proved beyond a doubt that the variety is thrifty and hardy," were his exact words. This same grower said that his few acres of young California trees gave him in 1911 a crop which he sold for \$10,000.

IMPORTANT AMENDMENT OF THE RECLAMATION ACT.

The President recently signed one of the most important amendments to the reclamation act. The latter has been on the statute books for ten years. About \$75,000,000 have been expended in building works which, although not yet completed, are already furnishing water to about 15,000 farms. One of the difficulties experienced by the settlers upon the public lands reclaimed under the terms of this act, has been that they could not obtain patent to the land until the water provided under the terms of the act had been paid for and thus they could not use the land as the basis for borrowing money to improve their farms and enable them to get a start.

The recent amendment provides that these settlers may obtain patent to the land upon compliance with the provision of law applicable to such lands as to residences, reclamation and cultivation. In other words, if they have lived upon the lands for three years, have reclaimed at least half of the irrigable area and have kept up the charges, patent can issue and thus the entryman will be in a position to borrow money upon his land.

While this is the primary object of the law, there are also other even more far-reaching provisions, the most important and radical of which is the absolute limitation of water rights obtained under the reclamation act to not to exceed 160 acres. Under the law as it formerly stood, it might be possible for a man or corporation to purchase several reclamation units and combine the farms into a considerable holding. Now, however, if this is done the water right will be forfeited and provision is made that any excess land over 160 acres which is acquired in good faith by descent, by law, or by foreclosure of the lien may be held for two years and no longer, and the excess holding shall be forfeited to the United States. This prevents consolidation of lands irrigated by works built by the government, and while it may work a hardship in some cases, it is believed will result beneficially. No large owner can thus enjoy the liberality of the government.

Attempts have been made in the past to evade the 160-acre limitation by subdividing the lands, putting the title in the names of near relatives, but it is probable that under the wording of this act such attempts to evade the letter of the law may jeopardize the ownership of the property to an extent at least to prevent any considerable evasion of the intent.

Another provision which will greatly add to the convenience of the water users is that permitting payment to be made directly to the local office of the reclamation service, instead of requiring payments to be made at the remote land offices involving in some cases expensive journeys. This also reduces the cost of accounting, as only one set of accounts need be kept, and that upon the project itself, cutting out the records which formerly have been maintained in the land offices.

Send \$1.00 for 1 year's subscription to the IRRIGATION AGE and bound copy of THE PRIMER OF IRRIGATION. If you desire a copy of The Primer of Hydraulics add \$2.50 to above price.

Supreme Court Decisions

Irrigation Cases

EXTENT OF RIGHT.

The extent of an appropriation of water rights is determined by the appropriator's need and facilities if equal, by the capacity of his ditch if his need exceeds the means of diversion, and by his need if the capacity of the ditch exceeds it. *Bailey v. Tintinger*. Supreme Court of Montana. 122 Pacific 575.

POLLUTION BY MINING WATER—

Though a person located on a mining stream and operating a placer mine is entitled to a reasonable and proper use of the channel and the water, he has no right to dump his mining debris into the channel or stream and allow it to be carried down by the water to the land of a lower riparian proprietor, or to fill up the channel to the injury of such riparian proprietor.—*Provolt v. Bailey*, Supreme Court of Oregon, 121 Pacific 961.

USE OF ANOTHER'S CANAL—

A person is not precluded from proceeding under Comp. Laws 1907, § 1288x22, to obtain permission to enlarge the irrigation canal of another because his application for unappropriated water was approved by himself in his official capacity as state engineer, since the statute gives the right to any person interested to protest any application, and the courts in a proceeding under Section 1288x22 have no power to pass upon and determine the water rights of the plaintiff.—*Tanner v. Provo Bench Canal & Irrigation Co.*, Supreme Court of Utah, 121 Pacific 584.

SALE OF BONDS—

Sess. Laws 1909, c. 146, providing for the creation of irrigation districts, and declaring in Section 44 that bonds issued by a district shall be sold, under the direction of the board of commissioners, for not less than 90 per cent and accrued interest, imposes no restriction on the board of commissioners of a district in exchanging the bonds of the district for property other than that imposed in making a sale for cash, and the board in exchanging bonds for property may allow only the statutory discount.—*O'Neill v. Yellowstone Irr. Dist.*, Supreme Court of Montana, 121 Pacific 283.

REVOCATION OF DITCH LICENSE—

A township completed an artesian well, sunk for irrigation purposes, for the inhabitants of the township, as authorized by law. Subsequently it obtained, without consideration, a license to discharge across the land of an individual the surplus water. It incurred no expense in exercising rights under the license, and there was no natural water course on the land of the individual along which the waters would naturally flow. Held, that the individual or his grantee could revoke the license at will.—*Butz v. Richland Tp.*, Supreme Court of South Dakota, 134 Northwestern 895.

PRIORITIES—

Where a landowner has appropriated and diverted water from a natural stream for the irrigation of his land and thereafter enters into an agreement with an irrigation company whereby he consents and agrees to relinquish and waive his water right from the stream and allow the irrigation company to collect the waters of the stream into reservoirs, and the company agrees in consideration thereof to deliver water to such landowner from the reservoirs and canal system, the priority of the original appropriator should properly date from the time of his first appropriation, diversion and application of the water to a beneficial use.—*Mellen v. Great Western Beet Sugar Co.*, Supreme Court of Idaho, 122 Pacific 30.

"MINERS' INCH"—

A contract to furnish a specified number of miners' inches of water for irrigation purposes is sufficiently certain to justify specific performance, where witnesses explain the meaning of the ambiguous term "miners' inch" and show that at the time of the making of the contract it was commonly understood that the term meant a quantity of water which would flow through an orifice an inch square under a four-inch pressure, and that a four-inch pressure meant a head of water which stood four inches above the top of the

orifice, and such testimony is not disputed.—*Ulrich v. Pateros Water Ditch Co.*, Supreme Court of Washington, 121 Pacific 818.

COMMON LAW RIGHT.

The custom of early settlers in California, which became a part of the common law of the country, recognized that an appropriation of water rights could be made by an actual diversion of water. Statutes later enacted provided a complete method of making an appropriation. Rev. Codes, §§ 4840—4891. Held, the statute intended to provide a method for the appropriation of water in addition to that fixed by early customs, and after its passage an appropriation might be made either by actual diversion or by compliance with its requirements. *Bailey v. Tintinger*. Supreme Court of Montana. 122 Pacific 575.

COMPENSATION FOR TAKING OF WATER RIGHTS—

In a proceeding under Comp. Laws 1907, § 1288x22, to obtain the right to enlarge an irrigation canal of another to carry water of plaintiff, the canal owner is entitled to recover damages for any land actually taken for any diverting appliances interfered with or affected, so as to require them to be changed, by reason of the enlargement, for temporary interference with the distribution of water, for the use by the applicant of portions of the canal which are wider than are required by the owner, if such wider portions have any substantial value, and for the decrease in the value of the canal by reason of the enlargement and use by applicant.—*Salt Lake City v. East Jordan Irr. Co.*, Supreme Court of Utah, 121 Pacific 592.

DAMAGES FOR ENLARGEMENT OF CANAL BY CITY.

In a proceeding by a city under Comp. Laws 1907, § 1288x22, to obtain the right to enlarge an irrigation canal owned by an irrigation company to carry water of the city, the company is entitled to any damages sustained by the corporate entity by the temporary interference with the distribution of water by defendant caused by the work of enlargement, but is not entitled to recover for damages sustained by the individual users of water through such temporary interference, although they may be stockholders of the corporation. *Salt Lake City v. East Jordan Irr. Co.* Supreme Court of Utah. 121 Pacific 592.

WATER RIGHTS.

Where a plaintiff, within 60 days after the posting of notice of appropriation of water of a running stream, had a survey and map made of the route of the proposed ditch from the proposed dam to the proposed place of use, to be used in applying for a permit from the federal government to construct the same over land in a forest reserve, and the survey was completed within 60 days, and plaintiff within 60 days filed his application with the United States authorities for permission to build the proposed dam, which application was pending, and plaintiff acted in good faith and prosecuted his application with reasonable diligence, he acquired such interest against subordinate adverse claims as to enable him to maintain an action to determine conflicting claims to the use of the water, but the judgment should not declare that plaintiff was absolutely entitled to the water, but it should only describe plaintiff's contingent right to use the water and enjoin adverse claims injurious thereto. *Merritt v. City of Los Angeles*. Supreme Court of California. 120 Pacific 1064.

Reclamation Act.—Under Reclamation Act June 17, 1902, c. 1093, 32 Sta. 388 (U. S. Comp. St. Supp. 1911, p. 662), which sets apart the proceeds of public lands in certain states and territories as a reclamation fund, to be used by the Secretary of the Interior in constructing, maintaining, and operating irrigation projects, the estimated cost of which is to be charged upon the lands irrigated and returned to the fund in annual installments, and which further provides that, when such payments have been made for the major portion of the lands irrigated from any works, the management and operation of the same shall pass to the owners of the lands, and the Secretary has authority to levy and collect assessments on the lands to defray the cost of maintenance prior to that time; it being the intention of the act that the fund should be full reimbursed for expenditures made therefrom and kept intact. *Baker v. Swigart*. U. S. District Court Eastern District of Washington, 196 Federal 569.

Reclamation Notes

CALIFORNIA.

The Saint Louis Company of Oakland has filed articles of incorporation with a capital stock of \$100,000 full paid. The purpose of the company is to instruct irrigation works. Directors of the company are Geo. W. Cox, Berkeley; John H. Thomas, Oakland; Walter de Varila, San Francisco.

Arthur L. Adams and S. V. Armstrong of San Francisco have purchased 1,100 acres of land lying near the town of Marysville. The ranch lies under a privately owned irrigation system which takes its water from Yuba river. It is the intention of Messrs. Armstrong and Adams to spend several thousand dollars on perfecting the irrigation and drainage systems, and in cutting up the land into smaller tracts for colonists.

Dr. Hall of Los Angeles has purchased 640 acres of land southwest of Tipton and will install pumping plants on each 100 acres and plant all the tracts to alfalfa.

At a meeting of the Turlock irrigation board, held late in September, the directors closed an option on a thousand acres of land which they held from the Warner Land and Development Company. The land is located a few miles south of Turlock and will be used by the district as a site for the reservoir which has long been contemplated.

An investment of \$10,000,000 will be made in an extensive irrigation project affecting the welfare of Yolo and Lake counties. White & Co., the New York bankers, are behind the project.

Incorporation papers for the Deer Creek Power Company, a concern composed of Chico stockholders, were filed recently. The company is formed for the purpose of engaging in the business of developing electric power for lighting and other purposes and to impound water in reservoirs for irrigation purposes. The capital stock of the company is given as \$1,000,000, divided into 10,000 shares of \$100 each. The main office of the company is located at Chico.

Articles of incorporation have been filed by the Orange Vista Irrigating Company, whose principal place of business is Los Angeles. The capital stock of the company is placed at \$10,000.

Articles of incorporation have been filed by the Solvang Water and Irrigation Company, principal place of business, Solvang. The capital stock of the company is given as \$15,000, of which \$3,950 is subscribed by twenty members of the Danish-American colony. The company plans to reclaim a large body of land in Santa Barbara county.

The Forestry officers at work surveying proposed reservoir sites on Rattlesnake creek, near Alturas, have located a proposed site in which 50,000 acre feet of water can be impounded. The reservoir would drain over eighty sections of land and the water, which runs to waste every spring, can fill the reservoir and give water sufficient to irrigate a large area of land. It is estimated that the cost of the system would be about \$100,000.

COLORADO.

The Acting Secretary of the Interior has approved the contract with the Grand Valley Water Users' Association, relating to the construction of the Grand Valley reclamation project, and has authorized the beginning of construction work. This approval was made upon the express condition that the government shall not be bound by the contract unless certain amendments to the articles of incorporation of the Grand Valley W. U. Association are made at the regular annual meeting beginning on the second Tuesday of January, 1913. This project con-

templates the irrigation of 53,000 acres of land in Mesa county. The work involves the construction of a diversion dam in Grand river, about 60 miles of main canal and a series of short tunnels in the first few miles of canal having an aggregate length of about 20,000 feet.

Western and European capitalists, represented in Denver, by W. L. Rucker, who was chiefly instrumental in working out the scheme of reorganizing and financing the Denver Reservoir Irrigation project, have taken over a number of irrigation projects in the vicinity of Durango, Colo., and Farmington, N. M. This company proposes to expend about \$850,000 in addition to the \$250,000 already expended, and to bring under cultivation 44,000 acres of rich farming land. The three projects which they have taken over are the Florida Mesa project, which contains 14,000 acres, a part of which is already under irrigation; the Hammond project, which contains about 12,000 acres and the Pine river project of nearly 22,000 acres. The work has been fully financed and actual construction work will be commenced at once. The company is under contract to furnish water on all the lands by May 1, 1913. No reservoir work will be necessary at present, but it will require the construction of 36 miles of canal for the Hammond project, forty to fifty miles for the Pine river project, while the Florida Mesa project is practically complete.

The Seaman syndicate of Denver has completed arrangements for dissolution. The debts of the syndicate will be paid in full and the farmers who purchased land on contracts have been guaranteed a title to their property. The syndicate purchased 12,000 acres of land and built a \$100,000 irrigation system and began selling land to high class settlers. Most of the land was sold on contracts which provided for the delivery of title upon completion of the payments. The company was unable to carry out its agreement and have had to turn the property over to eastern capitalists who will take care of the affairs of the company.

Sealed bids will be received up to October 31st by the Fruitland Irrigation Company for the moving and putting in place of 150,000 to 200,000 cubic yards of material by hydraulic method. Plans and specifications can be seen or had at the office of the company at Crawford, Delta county, Colorado. The plant is now installed on the ground.

The Secretary of the Interior has authorized the Reclamation service to complete the West Canal system, reconstruct the South Canal outlet, South Canal flume and structures on the Loutsenhoizer Canal, and to purchase the necessary right of way for the completion of the East Canal of the Uncompahgre Valley irrigation project. This work is necessary for the permanent and proper consolidation of the system and the extension of the canals to new lands under the project. The total expenditure involved is estimated at \$113,275.

IDAHO.

An irrigation project, which has for its ultimate purpose the irrigation of 15,000 acres of land lying above the Farmers' canal, commencing at a point seven miles east of New Plymouth and extending south and west, is well under way, according to reports from Payette. Water for irrigation purposes will be taken from the Farmers' canal, which will be enlarged to carry the extra volume of water which will be necessary for the new project.

Plans have been completed to start construction work on the Bruneau-Twin Falls irrigation project, which will ultimately reclaim 600,000 acres of land located south of the Snake river between the towns of Buhl and Bruneau. The cost of construction is estimated at \$20,000,000. Water for irrigating the project will be taken from the Snake river. A reservoir will be formed on this river by raising the Milner dam, thereby banking the water of the stream back up the river, submerging the town of American Falls, and creating a gigantic reservoir. The main canals will tap this reservoir above the dam and carry water to the project.

J. E. Kincaid, manager of the R. C. Beach Company of Lewiston, has purchased 2,400 acres of land near Pomeroy. The consideration, according to reports, was \$50,000. Of the total area there are 1,000 acres of plow land, 250 acres of irrigated bottom land, and the remainder will be utilized for pasture and grazing purposes.

C. H. Paul, constructing engineer in charge of the government reclamation project near Boise, is authority for the statement that excavation work for the foundation of the Arrowrock dam is progressing rapidly. The pit for the base of the dam is now between 50 and 60 feet deep. The bottom of the pit is within 15 feet of bedrock. The excavation work will continue to bedrock. Work will be continued throughout the winter months.

The Secretary of the Interior has announced that the

State Engineer Lewis has approved the application of W. C. Caviness for the appropriation of water of Cottonwood creek to irrigate 35,000 acres of land lying near the town of Vale.

It is reported that the Horsefly irrigation project, which has been organized under the state irrigation act, will be rushed to completion. The project has been approved by the state engineer and the bonds have been voted, and as soon as they are sold steps will be taken to have construction work begun. The project embraces about 25,000 acres of land, lying in the eastern part of Klamath county.

The government excavator is still at work on the drains on the first unit of the Klamath irrigation project, and the force at work has been doubled.



SHOWING THE THRIFTY GROWTH OF APPLE TREES IN NURSERY NEAR TWIN FALLS.
Left to right—I. B. Perrine, Twin Falls, Idaho; Wm. Preston Hunt, A. J. Lester and H. L. Hollister, Chicago.

water users under the south side pumping unit of the Minidoka irrigation project who availed themselves of the order of May 13, 1912, by which they agreed to pay \$1.20 per acre water rental instead of \$1.10 if payment was postponed to December 1, 1912, shall be allowed a discount of 5 cents per acre if payment is made on or before November 1, 1912, thus reducing the water rental charge to \$1.15 per acre.

OREGON.

The dam built by the reclamation service across Lost river to divert the waters of that river into the Klamath river, has been completed.

The Teel irrigation district, which embraces land lying south and west of Echo, has been formed and directors elected as follows: A. B. Thompson, O. D. Teel, Frank Sloan, E. E. Fisher and J. Frank Soinning; assessor, Peter Sheridan; collector, Charles E. Wells, and treasurer, A. Longwell, all of Echo.

The farmers of the southern part of Klamath county are agitating forming an irrigation district for lands above the gravity lines of the government canals and renting water from these canals. It is proposed to use electric power for pumping to the higher levels. It is reported that there are 1,400 acres in one tract, nearly 2,000 in an-

other and 600 in another, all of which can be reached by pumping less than 50 feet. The rate to be charged for the water has not been fixed, as that matter will have to be decided by the Secretary of the Interior, under the law which provides for the disposal of surplus water. This law was passed in February, 1911, and says that the Secretary of the Interior shall take into consideration the cost of the reservoirs and canals used for storing and carrying the water, and that he must protect the water users on the government project who pay the cost of these works, in fixing the rate.

The Secretary of the Interior has approved the recommendation of the director of the reclamation service to include additional areas within the west extension of the Umatilla irrigation project, which contemplates the irrigation of about 30,500 acres. There will now be included in this extension about 240 acres surrounding the town of Umatilla and about 850 acres of irrigable land below the Brownell ditch, and lying east of Umatilla. The latter area has a conceded water right and it is proposed to take over the ditch and water right and to charge the owners \$10 per acre for certain betterments of the canal which are needed.

The contract entered into between the Desert Land Board and the Northwest Townsite company of Philadelphia, the company behind the Paisley irrigation project, is said to be a model one. The contract provides that the irrigation company shall pay an extra \$250 a month to the board out of which there will be taken a sufficient amount to engage an experienced engineer who will act as inspector of the project.

Work on the second unit of the Klamath irrigation project has been started. A large flume will be built across Lost river at Olene. This second unit covers land in the Poe valley on both sides of Lost river, between Olene and Merrill. The Klamath project, on which work was begun in 1906, was originally planned to reclaim 200,000 acres of land. Of this, the first unit, covering approximately 30,000 acres, is completed and has been under irrigation since 1907.

The Fall River irrigation company has made application to the office of the state engineer for water from the Fall river for a Carey Act project of 2,500 acres of public and private land.

The Mackenzie Irrigation and Power company of Eugene, which recently filed on waters of Clear Lake, has announced that actual construction work on the irrigation canal and laterals will be commenced immediately. The proposed main canal will extend from a point 15 miles above Eugene on the Mackenzie to a point 5 miles northeast of that city. It will serve several thousand acres of rich valley land.

TEXAS.

The canal system of the Brownsville Irrigation company has been sold for \$57,000 to Frank J. Williford, Jr., of Houston, Texas. The property includes thirty-two miles of canals and about 2,700 acres of land, although the personal property of the company is not included in the sale.

J. D. Wagoner of West Stiles has bought 60 acres of land east of the city and will put same under irrigation.

The Business League of Ballinger has raised a special fund of \$1,000 to have a preliminary survey made for the \$1,000,000 irrigation project that is contemplated near that city. It is the purpose of the promoters to build a dam across the Colorado river at a point 20 miles above Ballinger and put water on 50,000 acres of fine agricultural land. The proposition will be financed by incorporating an independent irrigation district and issuing at least \$750,000 in bonds.

The Midland Engineering and Construction Company of Fort Scott, Kansas, has been awarded the contract for

the installation of a pumping plant to furnish the water supply of the town of New Braunfels. The company's bid was \$52,447.80. The contract covers the installation of a new pump, pipe line to the city reservoir, 280-horsepower engine and an electric light plant.

WASHINGTON.

Work was begun early this month on an irrigation project including the southwest quarter of the city of North Yakima, which will draw water from the Naches and Cowyche ditch and furnish it under pressure sufficient for all domestic purposes to more than 1,000 lots. It will be used for watering lawns and gardens, but not for drinking, and is designed to furnish at a minimum cost water for which the householders have to pay now at meter rates.

A. E. Gallagher of Spokane has purchased 53 acres of orchard land from the Modern Irrigation and Land Company in the Spokane valley. The tract will be put under irrigation, according to the terms of the sale, and the company agrees to furnish electricity for each ten acres. The entire tract will be planted to trees.

Yakima land owners on the Columbia river near the Hanford country have a movement on foot for the formation of an irrigation district to take over the Hanford project.

An irrigation project which will reclaim the land lying between Keystone and Ritzville is being planned by Messrs. Stone and Funk of Keystone. The plan is to take water from Sprague lake near the town of Keystone.

The Burbank irrigation system near Walla Walla has been taken over by the firm of Sanderson and Porter, engineers of New York City, for \$60,000, who will expend \$200,000 for improvements within a short time. The Burbank project was launched into 1905 through the efforts of A. B. Frame, who organized the Snake river irrigation company for the purpose of using Snake river power to raise water from the same stream to the high bench land that bordered it, but which was covered with shifting sand and sage brush. After a year of failure the project was taken over by the Pasco Power Company but in 1907 that company went into bankruptcy, and after eighteen months the company passed into the hands of the Burbank Power and Water Company. This company issued \$500,000 in bonds, all but \$100,000 of which was required to cover liabilities. The work of perfecting the irrigation system was continued until December, 1911, when a receivership was asked. The recent transfer to the New York firm was brought about by the foreclosure of a mortgage for \$500,000 held by the Farmers' Loan and Trust Company of New York.

It is reported that the Chicago, Milwaukee & St. Paul R. R. Company is planning to take over the \$5,000,000 Kititas high line canal bonds and will conduct a campaign to populate the lands along its line that will come under the big ditch.

The residents of Benton county have formed an irrigation district which means that an acreage approximating 5,000 acres will be brought under cultivation by the extension of the Sunnyside canal. This will require the construction of sixteen miles of main canal and some sub-canals. The tract to be put under irrigation fronts on the Yakima river and runs back to the hills and surrounds on three sides the town of Benton City.

MISCELLANEOUS.

Ten thousand acres of land in Gray and Ford counties, Kansas, are to be irrigated from the Eureka ditch. John Gilbert of Dodge City, a representative of the company back of the project, states that a water supply for 10,000 acres of land has been developed. The pump installed by the company will deliver this supply of water every day of the year, but that continual pumping may not be necessary the company has arranged to care for the river supply. A dam is now in course of construction that will turn the water from the river into the canal and thus supply water throughout the year.

The Canadian Pacific Railway Company has begun construction of a dam three miles southwest of its station at Bassano, Alta., Canada, which will be the largest of its kind in America. The lake created by this dam will be more than ten miles long, half a mile wide, and forty feet deep. Irrigating canals and ditches which will be fed by water controlled by the Bassano dam will have a total mileage of 2,500 miles and almost 600,000 acres of land will be irrigated by it.

The Kentucky Overhead Irrigation Company has filed articles of incorporation; capital stock, \$150,000. Its stockholders are Carl Houser, Shelbyville; F. H. Hibbard and F. H. Hibbard, Jr., and George P. Emrick of Louisville. The company purposes manufacturing irrigating machinery, buying and developing real estate and water rights.

The state engineer of South Dakota has granted a permit to Mattis Haivala and Lizzie Haivala of Buffalo county to take water from Bad Lands and Haivala creeks for irrigating 199 acres, and to E. M. Sedgwick and Colen Blunck of Presho, to appropriate water from White river for the irrigation of 383 acres.

That the first unit of the Prickly Pear Valley irrigation project in Montana will be completed within the next two months, is announced by M. H. Geary, who is in charge of the enterprise. This unit consists of 8,000 acres of land which will be brought under the ditches being constructed by the Missouri River Electric Power and Irrigation Company.

The Director of the Reclamation Service is asking for proposals for furnishing gates, valves, operating machinery and appurtenances for Lahontan dam, on the Truckee-Carson project in Nevada. The bids will be opened at the office of the U. S. Reclamation Service at Fallon, Nevada, on November 21, 1912.

The Director of the Reclamation Service is asking for proposals for the construction of about ten miles of the

Dodson North Canal, Milk River project, Montana. The work involves the excavation of about 420,000 cubic yards of material and is situated on the north side of Milk river and adjacent to the main line of the Great Northern Railway in the vicinity of Wagner and Exeter, Montana. The bids will be opened at the office of the U. S. Reclamation Service at Malta, Montana, November 11, 1912.

THE IRRIGATION OF ALFALFA.

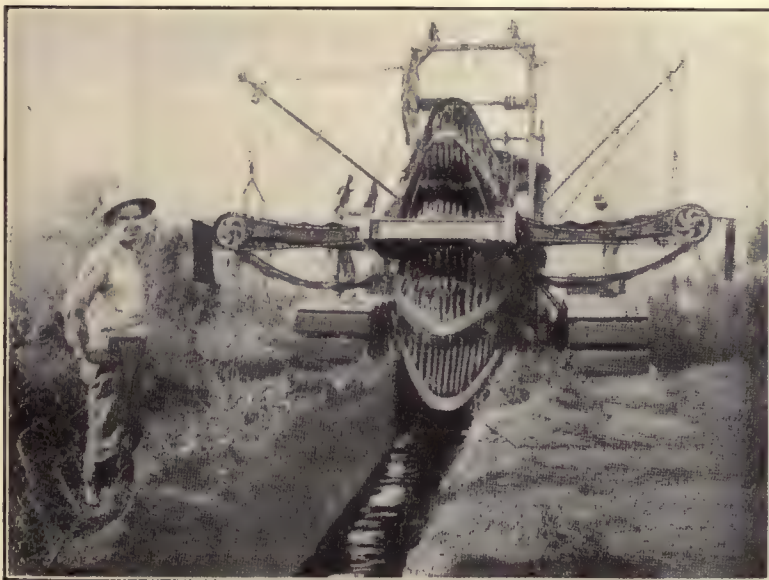
(Continued from page 434.)

land to a depth of seven feet. This is equivalent to a precipitation of eighty-four inches, and is very evidently too much. Of course, this water does not pile up evenly on the land. It does, however, run over the fields, washing out the available plant food, filling up the soil so as to exclude the air and bring the alkali to the surface, and making swamps of the lower lands.

Many irrigation farmers entertain the mistaken notion that water is plant food. Water is the dissolver and the carrier of plant food, and must be used for these purposes. If supplied in proper quantities, it moistens the soil and makes conditions favorable for growth. If too much is applied the effect is sure to be harmful. After the soil has been wet down four or five feet the addition of water ought to be discontinued. To pour more on only fills up the lower soil layers, shutting out the air and making conditions unfavorable for root development, or, in case of soils where the subsoil is open, washing through and carrying the dissolved food with it.

Irrigation farming controls one more factor than is controlled in humid agriculture. The irrigator may have rain when he needs it. In western Canada, where the soils are stored with much accumulated plant food, where the hours of sunshine during the growing season are greatly in excess of those in eastern localities, the conditions for very high production are most favorable. An irrigation system properly utilized practically insures maximum crops every year. The irrigation farmer should inform himself so that he may put the system to its proper use.

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Article III.	Geometrical Principles.
Article IV.	Trigonometry.
Article V.	Mensuration of Plane Figures.
Article VI.	Mensuration of Solids.
Article VII.	The Principles of Mechanical Forces.
Article VIII.	The Three States of Matter.
Article IX.	General Hydraulic Principles.
Article X.	The Coefficient of Roughness.
Article XI.	How to calculate n .
Article XII.	Explanation of the "C" Tables.
Article XIII.	Open Channels—Problems.
Article XIV.	Closed Channels—Problems.
Article XV.	Pipes Flowing Full Under Pressure.
Article XVI.	Loss of Head by Enlargement of Channel.
Article XVII.	Subdivisions of Channels.
Article XVIII.	Loss of Head at Entrance to Pipes.
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Article XX.	Ditch Tables and Their Applications.
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Fourteen tables giving the factor C for all cases of channels for a coefficient of roughness; n varying from .008 to .050, inclusive, for channels having a hydraulic radius from .01 ft. to 900.0 and for slopes varying from 0.1 to .000025, thus practically covering every possible condition.

Tables of square roots of numbers used for r and s .

Table of Hydraulic Elements of the Circle.

Table of Hydraulic Elements of Composite Section.

Table of Areas and Circumferences of Circles.

Table of Hydraulic Equivalents.

Table of Weights of a Cubic Foot of Various Substances.

Conversion Table of United States and Metric Measures and Weights.

Table of Squares, Cubes, Square Roots and Cube Roots.

Table of Logarithms.

Table of Natural Sines and Cosines.

Table of Natural Tangents and Cotangents.

Conversion Table, millions of gallons in 24 hours in other units.

Table of sizes of pipes or cylindrical conduits required for the flow of given quantities of water at given velocities.

Most all of these tables have been originated and computed by the author and have been checked in practical work and found to be correct, so that the tables alone will be worth many times the cost of the book.

The price of the book has been placed as low as is consistent with the superior quality of the work and it may be obtained on the following terms: \$2.50 a single copy, cloth bound; if order is sent with a new subscription to Irrigation Age or a renewal subscription, the book will be sent and the Irrigation Age one year for the sum of \$3.00.

Postage is included in the above prices.

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THE PRIMER OF HYDRAULICS.

The following is reproduced from a recent issue of the *Engineering News*. We thank the *News* and Mr. Gregory for this extended review and will state that the slight errors mentioned will be corrected in the second edition:

Hydraulics in Simple Form.

THE PRIMER OF HYDRAULICS—By Frederick A. Smith, Hydraulic Engineer; Asst. Engr., Dept. Public Works, Chicago, Ill.: D. H. Anderson, cloth; 5½x7¾ inches; pp. vi + 217; 110 text figures; 22 tables. \$2.50, net; flexible leather, \$3.50 net. Reviewed by John H. Gregory.*

In the "Primer of Hydraulics," consisting of 22 articles and 207 pages, the author has presented much information which will be of service not only to a beginner first

*Consulting Engineer and Sanitary Expert, 170 Broadway, New York City.

taking up the study of hydraulics but also to the practicing engineer. In the first eight chapters, or articles as they are designated in the book, the author, in simple language, takes up the General Properties of Matter, Algebraic Principles, Geometrical Principles, Trigonometry, Mensuration of Plane Figures, Mensuration of Solids, The Principles of Mechanical Forces and The Three States of Matter.

In the following article General Hydraulic Principles are discussed and the well known Kutter formula for computing the flow of water is presented. The author lays special stress on a new form of channel, which he terms a composite section, especially adapted to accommodate a small dry-weather flow and a considerable flow of storm water. The lower part of the section is formed by two lines at right angles to each other, each line being inclined at an angle of 45 degrees to the horizontal. The upper part of the section is formed by a circle, the two lines forming the lower part of the section being tangent

WHAT THE TIETON PROVES.

That irrigated lands are in demand in Washington was conclusively shown at the opening on May 25 of approximately 40 small irrigated farm units in the Yakima Project. Notwithstanding the very small number of farms available, and the exacting restrictions imposed as to residence, cultivation, and the cash deposit of about \$400 required with each application, 225 entrymen applied for the land. Their aggregate deposits in the land office amounted to \$100,000. The water right charge for these lands is the highest ever assessed by the government, being \$93 per acre. In addition, the settler must pay an annual assessment of \$1.50 per acre for maintenance and operation.

A QUESTION.

How much do your shoes cost you?

Mental answers of \$3, \$4, \$5, etc., will probably be made in great numbers to this question, but there is a surer way than that of finding out what your footwear costs.

An advertisement of "Ball Brand" rubber footwear points out that a boot costing \$3 that wears three months is more expensive than a \$4 boot that wears six months.

The "Ball Brand" people insist that the way to figure the cost of rubber footwear is on the cost per day's service or week's service, if you prefer.

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It is said that a great railroad president cut his operating expenses down 30 per cent when he finally discovered his unit to figure on. The unit was the lowest cost of hauling a ton of freight a mile.

You might apply that unit idea of cost per day's wear to boot buying. It is conceivable that it would warrant the purchase of "Ball Brand" boots.



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takes the place of both lath and plaster. It is put on easily and quickly—nailed direct to the studding. There is no muss—no waiting for it to dry—and once in place it is there to stay as long as the house lasts—It will not warp, or crack, or shrink—It may be decorated in any style desired—It is more economical than lath and plaster. *It is the Ideal covering for walls and ceilings.*

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to the circle below the horizontal diameter. A somewhat similar section is considered in the "Taschenbuch für Kanalisations-Ingenieure," by Dr. Ing. Karl Imhoff (Essen, Germany, 1907), except that the lines forming the lower part of the section are inclined at less than 45 degrees to the horizontal and the upper part of the section is square or rectangular.

Three articles are devoted to The Co-efficient of Roughness, How to Calculate " n ," and Explanation of " C " Tables.

The following seven articles take up and work out the solution of problems involving Open Channels, Closed Channels, Pipes Blowing Full Under Pressure, Loss of Head by Enlargement of Channel, Subdivision of Channels, Loss of Head at Entrance to Pipes, and Ditch Tables and Their Application. The last two articles are devoted to Flow Measurements and the Use of Logarithms.

The book ends with a series of useful tables. In the first thirteen tables are given values of c in Kutter's formula for various values of n , V , r and s , followed by tables of numbers and their square roots, used principally for r and n . Two tables are devoted to giving the hydraulic elements of circular and composite sections partly filled. The remaining tables include Areas and Circumferences of

Circles, Hydraulic Equivalents, Weights of Various Substances, Metric Conversion Tables, a table for converting the flow of water from one unit to another, a table for determining the size of circular conduits with given velocities and volumes of discharge, and tables of Squares, Cubes, Square and Cube Roots, Logarithms and Natural Sines, Cosines, Tangents and Cotangents. Of the tables given those relating to hydraulics are of the most value, especially the tables giving the value of c .

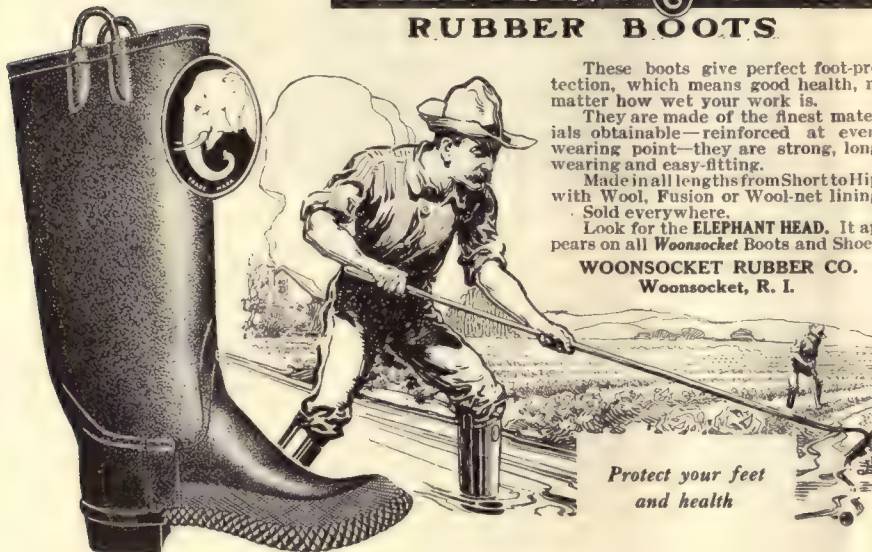
The book would be materially increased in value by the addition of diagrams for the use of the many engineers who prefer to read directly the corresponding size, slope, velocity and discharge instead of having to compute the same, even with the assistance of conveniently arranged tables.

One or two errors have been noted in one of the tables, but it is recognized that some errors are almost sure to occur in the first edition of any book. It is to be hoped that, with a second edition of the book, the author will see fit to adopt the size of page so widely used in the numerous engineering handbooks and also to bind the book in a similar manner, changes which could be readily made and which would not involve any resetting of the type.

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But he will not attend to them properly unless he can do so with comfort and safety to his health. The best way to guard your health and add to your comfort while doing this work is to wear

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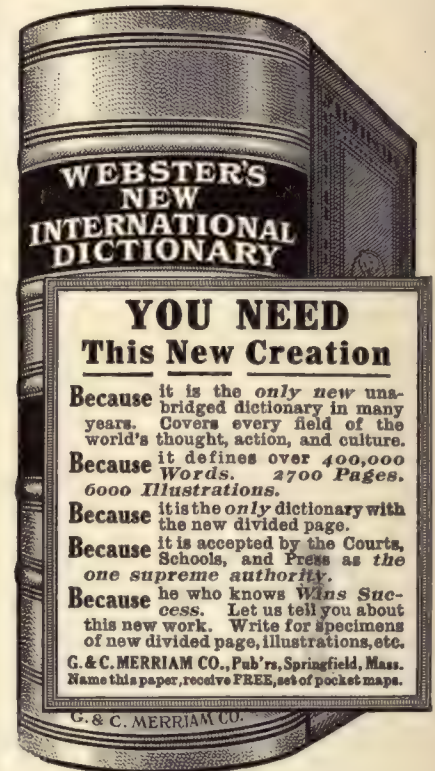
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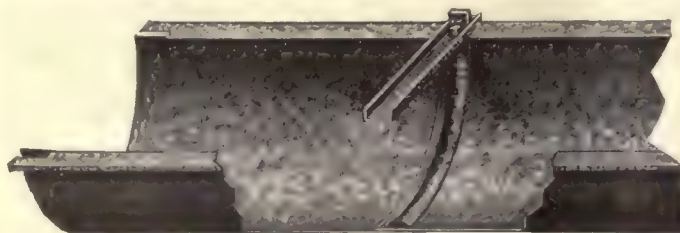
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MONTHLY DIGEST

Of Important Law Points Recently
Decided by the Secretary of the
Interior.August, 1912.
Homesteads.

Credit for military service under section 2305 Revised Statutes applies only to residence and not to any cultivation that may be specifically required.

Section 4 of the act of February 19, 1909, requires, among other things in making final proof on entries under the revised statutes, proof also of cultivation of specific portions of the entry from year to year.

Obviously the specific requirements of said act as to cultivation cannot be affected by the previously enacted section 2305 R. S., allowing credit as to residence on homestead entries for military service.

Isolated Tracts.

Under the provisions of the act of April 30, 1912, isolated tracts can be sold and entered with a reservation to the government of the coal rights. In such case the entryman should signify his willingness to accept a limited patent.

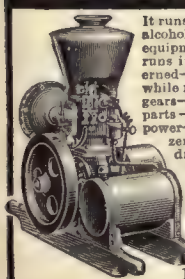
Practice.

In a contest between two entrymen, who in good faith settle upon two adjoining homesteads, simultaneously, their rights will be equitably adjusted by the department.

NOTE—In the above case, the department follows the reasoning in Williams vs. U. S. (138 U. S. 514), and overrules the case of Sumner vs. Roberts (23 L. D. 201.)

It has often been held by the department that, where an entry has been erroneously allowed in violation of the rule of approximation, said entry may remain intact subject to consideration by the Board of Equitable Adjudication, when it is shown that such entry could not be reduced without forfeiture of the improvements of claimant.

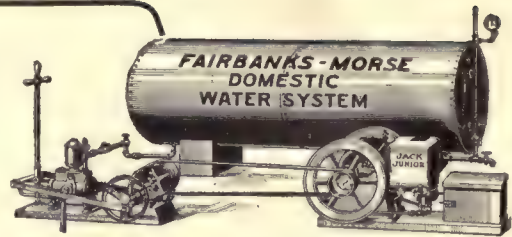
Information as to proposed restoration of lands will not be given out in advance of the publication of Executive orders affecting such lands, not even to those asserting claims, as such information might embarrass the department in its adjudication of such claims.

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are the easiest running, longest lasting wagons you can buy because the lumber used is carefully selected—first grade oak and hickory for wheels, the finest yellow or bay poplar for box sides, and the very best long-leaf yellow pine for box bottoms.

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California's Wealth and Progress Since Early Days Due Largely to Her Mountain Streams.

The great part which the water resources of California have had in the development of the state is evident throughout its history. In 1848 some repair work being done on a mill race near Georgetown in Eldorado county led to the discovery of gold, and this was followed by the rush of the "forty-niners," whose exploits have become classics in min-

ing literature. The subsequent development of gold mining in California was due largely to the location of the deposits near the water necessary for hydraulicking. Moreover, the water available for irrigation and domestic supply has been the chief factor in the development of southern California, which now has a population of over a million people. The growth of the extensive irrigation systems in the great interior valley of the state is bringing about the subdivision of this area into small ranches devoted to intensive farming, which affords almost limitless opportunities to the agri-

culturist. Again, an increased water supply for the city of San Francisco is urged as one of its greatest necessities, and more water for Los Angeles is to be brought from Owens Valley—a distance of more than 200 miles—at a cost of \$23,000,000.

Many torrential streams of California afford abundant power, the utilization of which in manufacturing enterprises and in transportation has been made possible by the progress of electric power transmission during the last decade; today California probably leads the United States in the number and length of her power transmission lines.

Information concerning the quantity of water carried by California streams has therefore been and will continue to be a highly important factor in the development of all these resources, for the fundamental importance of stream flow data is now so thoroughly recognized that it is almost impossible to finance any project depending upon stream flow without presenting authentic records of flow covering a period of years.

[From advance sheets of water supply paper 298, U. S. Geological Survey.]



The Brevoort

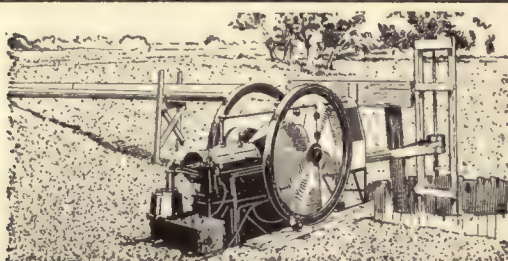
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Send \$1.00 for The Irrigation Age one year and the Primer of Irrigation, paper bound.

SOME PHASES OF IRRIGATION IN RELATION TO FRUIT FARMING.

(Continued from page 427.)

plots. The poorer soil was given heavier irrigation while the better were given intensive cultivation but no irrigation. The results favored non-irrigation, showing that irrigation can not be made to make up for a poor quality of soil.

In all cases cultivation is a most important feature in connection with irrigation. If the ground is given thorough cultivation in spring, and a mulch maintained during the growing season, the soil will be in a better condition to receive the water, and a more economical use of the water is allowed. Irrigation should merely supplement good tillage, and the importance of thorough tillage during the growing season can not be over-estimated.

Good drainage, natural or artificial, is necessary where large amounts of irrigation waters are used. Where drainage is poor seepage waters and alkali often destroy many of the orchards. Often the excess irrigation does not injure the lands of the man who practices it, but those of his neighbors at a lower level.

We found the temperature of the water to be a subject requiring more attention. With well water there is a tendency toward fairly constant temperature throughout the season. It may be made to increase its temperature, however, quite materially by various methods of distribution. In one test we found that the water increased 8.5 degrees in flowing in open furrows from the well to the

point of distribution. It was still further increased in passing through the distribution rills in the orchard. There was a much greater increase in the afternoon than in the morning.

When water was used from a large irrigation ditch during July and August, the water was found to be of the same temperature as the soil early in the morning, but was greatly increased in the afternoon, in some cases 15.5 degrees over the morning temperature. This would mean, where the soil tended to be a little heavy or where the water tended to run a little too cold, that injury could result from irrigation.

In some cases, where the temperature of the water was higher than that of the soil, there was a slight decrease in the temperature of the water when it flowed through the furrows, especially if these were located in the shade of the trees. In all cases when temperatures were read, it was found that the soil had decreased in temperature immediately following irrigation. This decrease was more noticeable in surface soils than at greater depth. In some cases there was as much as 3 degrees difference in temperature in the first foot, and this gradually decreased at 4 feet in depth, while in other cases the soil temperatures remained the same at a depth of 3 feet and below.

From the investigations we have been able to make we can determine easily that irrigation is a big subject having many phases, and one which is going to require our closest and most careful study if we are to bring trees to their highest degree of productiveness.

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of Irrigated Lands Offered on
Most Liberal Terms.**

The Victorian government during the past two years has outlined an enormous irrigation plan, which places on the market as fine lands as can be had anywhere with ample water supply.

These lands are capable of producing citrus fruit and apples in the same orchards. Wheat, corn and alfalfa are staple crops. Dairying a very successful industry. Lands are now offered to settlers at prices ranging from \$30 to \$100 per acre, and allows 31½ years for payment of purchase price. Excellent climate resembling California.

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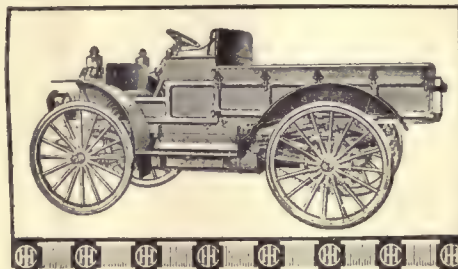
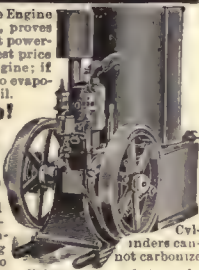
Amazing "DETROIT" Kerosene Engine shipped on 15 days' FREE Trial, proves kerosene cheapest, safest, most powerful fuel. If satisfied, pay lowest price ever given on reliable farm engine; if not, pay nothing. No waste, no evaporation, no explosion from coal oil.

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Every day you run an International auto wagon you will find it more useful to you. With it you can make the trips you used to neglect, because you did not want to take the horses from their work. Perishable products are handled speedily, or taken to the most profitable market. Best of all, the car saves money as well as makes it.

International Auto Wagons

help make farm life pleasant. It is a pleasure to run the car and it is so reliable, so ready to go at any time or for any purpose that it soon becomes indispensable. It can be used in all seasons when the road is passable to horses. The wheels are high enough to give ample road clearance. Solid tires give good traction and eliminate many tire troubles. The engine is simple and powerful. Fuel and oil to run an International auto wagon cost less than the feed for a horse, while the wagon will do from two to four times as much work.

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GET A HOME IN NEW MEXICO, THE NEW STATE, where land is cheap and life worth living. Ideal climate. We sell no lands. Write today for book "I" with map. It's free.

State Immigration Board,
Albuquerque, N. M.

COLORADO FARM BARGAIN. 160 ACRES choice land, fenced, house and outbuildings, dandy well, pure water at 25 feet; near school and town; fine proposition for practical farmer. Only \$3,200. \$750 cash, balance to suit, 6%. F. E. Hammond, 321 Colorado Building, Denver, Colorado.

900 ACRES, NEAR DEL NORTE, 2 SETS improvements, fenced, cross fenced; all cultivated; paid up old water right. \$75 an acre, terms. Cole & Snyder, 1650 Champa Street, Denver Colorado.

80,000 ACRES, NEW MEXICO; 20,000 SUBJECT to irrigation; 10,000 underlaid with coal; excellent colonization proposition. For reports, information, write Sutton, 203 Symes Building, Denver Colorado.

ADJOINING BEST TOWN IN NORTH- eastern Colorado, a 665-acre irrigated tract, 600 acres in hay, cutting 1,000 tons yearly. Free water rights. Best section Platte Valley on Union Pacific Railroad. Owner will accept one-third cash, balance in one-half of hay crop for first five years. Price \$90 per acre. For further particulars, Globe Investment Company, 434 17th St., Denver Colorado.

REAL ESTATE, IMPROVED IRRIGATED Farms. We offer a splendid opportunity for the investor and for the home seeker. Land bought now at Antonito will make a better living for the farmer and show a larger increase in value for the investor than any place in the world. We can sell you improved irrigated farms with the best water rights for \$50 to \$60 that will produce crops that will pay the purchase price in two years. A card addressed to the undersigned will bring you all the information you desire regarding this wonderful opportunity. W. D. Carroll, Antonito, Colorado.

DO YOU WANT INFORMATION? OUR business is giving information. Any subject, any place. We buy any article for you, tell you where to buy it. Anything you wish to know ask us. The National Information and Buyer's Agency, 1426 E. 22d Avenue, Denver, Colorado.

A WELD COUNTY BARGAIN.—I AM THE owner of a 320-acre tract, near the growing town of Ault, on the Union Pacific Railroad, with Cheyenne, Greeley and Denver convenient market places. Excellent grain land. Will sell for \$12.50 an acre. \$1,000 cash, balance in three annual payments at 6% interest. Investigation invited. One of the best and cheapest "buys" in northern Colorado. J. I. Carper, Chamber of Commerce Bldg., Denver, Colorado.

60,000 ACRES IN ONE BODY IN ARCHU- leta county. Finest stock ranch for horses, sheep or mules. Stumpage value alone \$60,000. Fine water power and irrigation possibilities, also petroleum. Price \$3.00 per acre. E. W. Merritt, 708 17th Street, Denver.

FOR INFORMATION REGARDING IRRIGATED lands in the vicinity of Saguache. Fine lands at \$10 to \$100 an acre. Only set of abstract books in county. All inquiries cheerfully answered. The Saguache County Abstract and Improvement Co., W. M. Slane, Mgr., Saguache, Colo.

IN THE GARDEN OF EDEN, OTHERWISE called Montezuma county, near Dolores, 120 acres finest soil known; raises everything. 10 acres in 4-year-old apples, raised forty bushels of wheat to acre last year, finest hay and sugar beet land. 12 foot vein bituminous coal under entire ranch. Price, \$6,500. Wonderful bargain. E. W. Merritt, 708 17th Street, Denver.

HOME AND INVESTMENT LANDS, LA Jara district. Choice irrigated lands improved, unimproved, \$45 to \$85 acre. Wilson & Rucker, La Jara, Colorado.

SEVERAL GOOD SHALLOW WATER, 160 acres and up; farms deeded and relinquishments cheap. Will make splendid irrigated farms by installing pumping plants. Plenty good range. F. J. Shindler, Eads, Colo.

FREE ILLUSTRATED BOOKLET AND price list irrigated fruit and farm lands western Colorado. Also offer interest in good irrigation project full of merit, close to Delta, in operation. Welch & Merrill, Delta, Colo.

I AM READY TO BUY ANY TRACT OF good land in the San Luis Valley for cash. I buy for cash and can sell at lowest prices. Walter N. Ickes, Alamosa, Colorado.

FINE RANCH AT DEL NORTE IN SAN Luis Valley. Close to city, Rio Grande river flows through. Fine buildings and timber, splendid stock ranch. Plenty of hay. Price, \$12,000 for 240 acres. E. W. Merritt, 708 17th street, Denver.

FOR LANDS IN THE SAN LUIS VALLEY with best water rights at prices from \$30 to \$100 per acre, see me. I have farmed 14 years and sell only good farming land. J. C. Milyard, Alamosa, Colorado.

I HAVE SOLD LAND AT MOSCA FOR 4 years. I am a practical farmer. Have 1,600 acres which I own and will sell for \$30 to \$75 an acre. All cultivated. Good water right. W. W. Saunders, Mosca, Colorado.

IRRIGATED LANDS IN THE LA JARA District, \$50 to \$60 per acre. I specialize in farm loans, insurance and have San Luis Valley irrigated lands for sale at all times. C. L. Smith, La Jara, Colo.

IDEAL STOCK RANCH IN THE FAMOUS San Luis Valley, Colorado. 1,440 acre stock ranch near Center; 6-room house, barn, corals; 10 artesian wells. Sacrifice, \$35 an acre, one-third down, balance easy. 100 choice cows and 50 head horses. Choice San Luis Valley lands \$40 an acre. J. W. Hess, Mayor of Center, Center, Colorado.

LA JARA'S LAND FIRM—NO TROUBLE to answer inquiries. An active land firm in La Jara that gives its patrons a square deal and refers to the La Jara State Bank as to its financial responsibility. Good land, perfect water rights, reasonable terms. Write for illustrated folder. Seeley & Dougan, La Jara, Colorado.

IRRIGATED LANDS IN THE PECOS valley, Texas. 25,000 acres of richest fruit and alfalfa land in country. Six cuttings of alfalfa yearly, averaging over ton per acre each cutting. Every known crop grown. The Orient Railroad, builder of irrigating system, runs to tract direct and connects with three other roads, affording direct lines to markets and Gulf ports. Ideal climate. Elevation 2,400 feet. Over one-half tract sold, 7,000 acres being cultivated. Detailed information, Wray and Trimmer, 410 Ideal Building, Denver, Colorado.

WE HAVE 20,000 ACRES OF GOOD ranch land in New Mexico, that we are dividing into ranches of from 640 acres up. Running water on most of the tracts with some timber and abundance of grass. This land will be divided so that there will be valleys on all of the tracts susceptible to irrigation which will produce all kinds of grain, fruit and 5 tons to the acre of alfalfa. The winters are mild and you do not have to feed. Parties wishing to raise mules, horses, sheep and cattle should make big money on their investment. The price ranges from \$7.50 to \$15.00 per acre, according to size and location. We also have 15,000 acres of irrigable land. Price \$50.00 to \$100.00 per acre. Write us at once. The Rayado Colonization Company, 1646 Tremont Street, Denver, Colorado.

COME TO VIRGINIA

Homes for all, health for all, happiness and independence for all. Ideal climate; no malaria, no mosquitoes. Write for our land bulletin which will interest you.

J. R. Meadows, Appomattox, Va.

FOR SALE—AT LESS THAN COST. A manufacturing plant engaged in the manufacture of irrigating machinery. Upwards of 20,000 feet of floor space. Six acres of ground. Equipment and buildings nearly new. Write for full particulars to Box 85, Irrigation Age, Chicago, Ill.

FOR SALE AT A SACRIFICE, 320 ACRES near Alamosa, San Luis Valley, Colorado. 320-acre relinquishment near Rocky Ford coming under irrigation, \$1,000. We have all kinds of ranch and farm and city property to exchange. Tell us what you have and we will get you what you want. If you are coming west, write us, we have some fine irrigated land and large ranches to trade for eastern property.

L. J. MOUNTZ & CO.,
Real Estate and Mining Investments,
1743 Champa Street, Denver, Colo.

FOR SALE

160 acres fine land in famous Yellowstone Valley, E. Mont. Near R. R. Very level. Under Gov't Irrigation. Good for grain, Alfalfa, Vegetables, etc. Only \$25 an acre. Will be worth \$50 soon. Owner a non-resident and not a farmer. W. B. OVERSON, Owner, Williston, N. D.

COLORADO LANDS LA PLATA COUNTY

Bayfield, the center of one of Colorado's richest and most fertile irrigated sections, was less than 10 years ago a sagebrush wilderness. Today it is a populous and thriving town. I am a practical farmer, have farmed around Bayfield 12 years; I have some fine irrigated land to sell on easy terms as low as \$30 an acre. I will locate you on government land or sell you a relinquishment. Write me today. W. R. MALOY, P. O. Box 56 BAYFIELD, COLO.

IRRIGATED LANDS IN THE ROMEO DISTRICT OF THE Famous San Luis Valley

No Alkali, Good Drainage,
Guaranteed Water Rights.
Handsomely Illustrated Booklet for the Asking.
ZEPH. CHAS. FELT, President
561 Boston Bldg., DENVER, COLO. or ROMEO COLO.

BINDER Attachment with Corn Harvester cuts and throws in piles on harvester or winrows. Man and horse cuts and shocks equal with a Corn Binder. Sold in every state. Price \$20.00. W. H. BUXTON, of Johnston, Ohio, writes: "The harvester has proven all you claim for it: the harvester saved me over \$25 in labor last year's corn cutting. I cut over 500 shocks; will make 4 bushels corn to a shock." Testimonials and catalog free showing pictures of harvester. Address New Process Mfg. Co., Salina Kansas

PATENTS

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If you have an invention or any patent matter, write immediately to W. W. WRIGHT, registered attorney, Loan & Trust Bldg., WASHINGTON, D. C.

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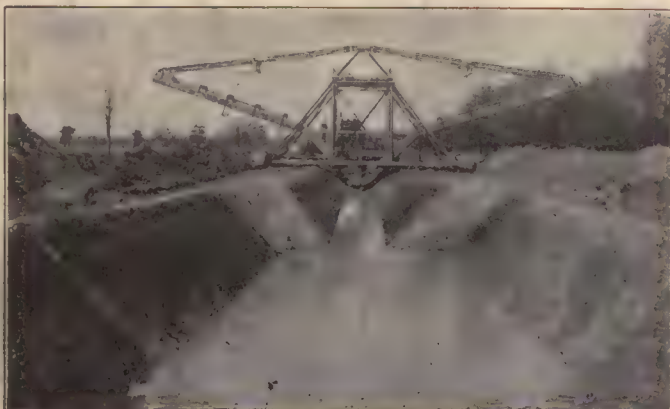
VOL. XXVII

TITLE REGISTERED U.S. PATENT OFFICE

NO 2

CHICAGO, DECEMBER, 1911

THE TWO SIZES OF DITCH



Ditch Being Dug with Sloping Banks—An Austin Drainage Excavator Ditch, showing variations in width made by same machine

shown in the accompanying view were dug by the machine illustrated. This machine can dig any other sizes between the two shown, with any slope of bank desired. All that is necessary to accomplish these changes is to alter the guide frame (templet) which carries the self-cleaning excavating buckets.

This

Austin Drainage Excavator

ditch looks like a ditch, doesn't it? It looks like a ditch that will stand, and it **will** stand—because the sides are sloped, the spoil banks are away from the edges, the cut is made cleanly without disturbing the ground outside the section.

OUR FULL LINE COMPRISES

The Austin Drainage Excavator
The Austin Levee Builder
The Austin Drag Line Excavator
The Austin Side Hill Ditcher

The Austin Highway Ditcher
The Austin Orange Peel Ditcher
The Austin Sewer and Water Works Excavator.

The Austin Pipe Line Excavator.
The Austin Tile Ditcher
The Austin Stump Puller and Grubber

Any of these machines can be mounted on a float, on wheels, skids, track rails, or rolling platform traction. Motive power, steam or gasoline.

F. C. Austin Drainage Excavator Co.

Railway Exchange, CHICAGO

(25 YEARS' PRACTICAL EXPERIENCE BUILDING EXCAVATING MACHINERY)

Please cut this out

REMINDER

To write to F. C. Austin Drainage Excavator Co., Railway Exchange, Chicago Ill., for Free Book "S" on Modern Methods of Excavation.

MORRIS MACHINE WORKS

BALDWINVILLE, N. Y.

Centrifugal Pumping Machinery, designed for any irrigating or dredging proposition. Send details or specifications of what is wanted and we will recommend a pumping outfit to supply the need.

New York Office, 39-41 Cortlandt Street
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San Francisco and Los Angeles, Cal.
H. A. PAINE, Agent, : : : Houston, Texas



D. H. ANDERSON, Publisher

CHICAGO, ILLINOIS

Myers Power Pumps

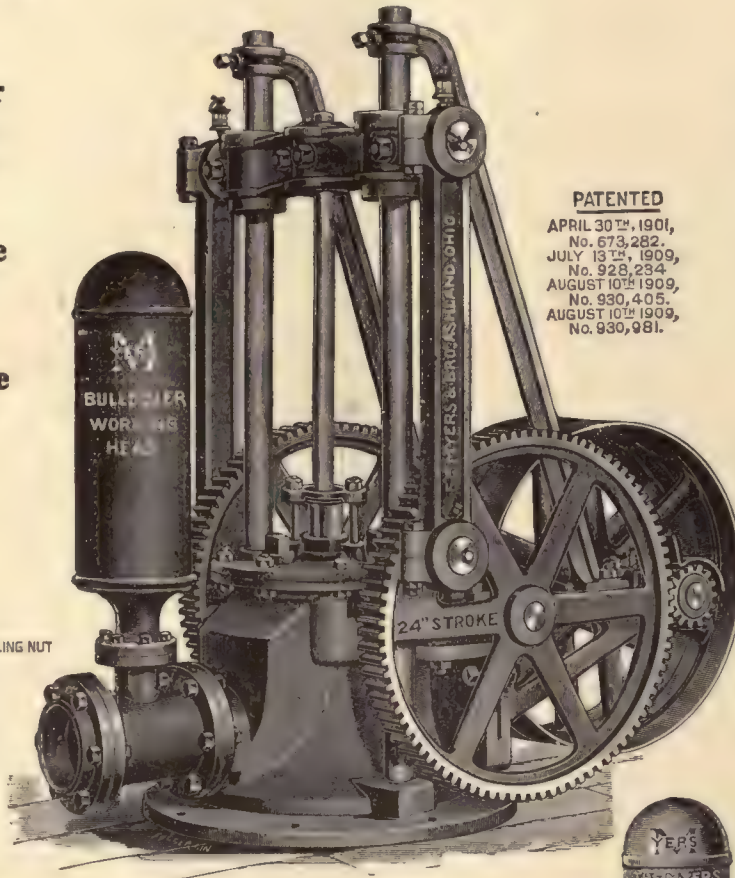
Working Heads, Pumping Jacks, Cylinders, Etc.

PATENTED

The Myers
Bulldozer Power
Working Heads
For Deep Wells

Length of Stroke
5 to 24 inches

Size of Discharge
Up to 6 inches



PATENTED
APRIL 30TH 1901,
No. 673,282,
JULY 13TH 1909,
No. 928,234,
AUGUST 10TH 1909,
No. 930,405,
AUGUST 10TH 1909,
No. 930,981.

PATENTED

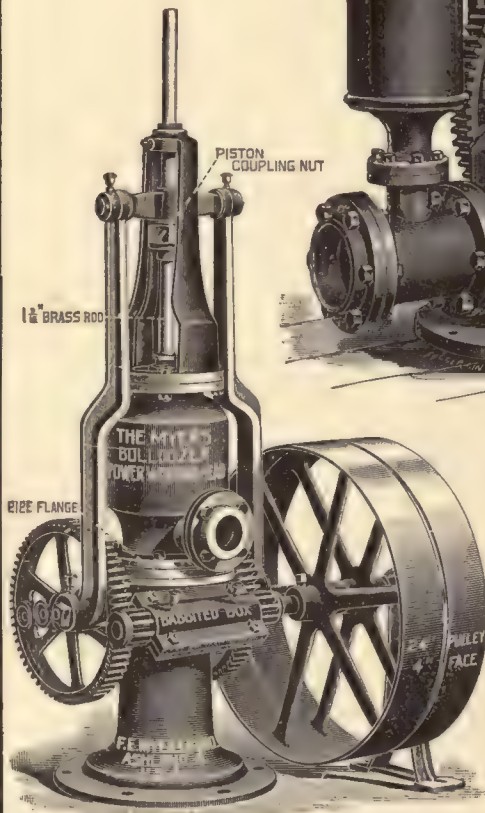
The Myers
Bulldozer
Power Pumps
For
Shallow Wells

Double Acting
Length of
Stroke
5 to 20 inches

Size of
Cylinders
2½ to 6 inches

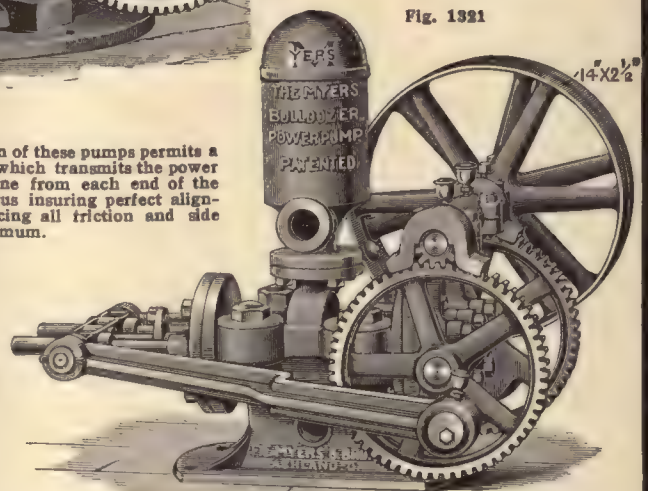
Size of
Discharge
Up to 4 inches

Capacities
600 to 7200 Gallons
per Hour



The construction of these pumps permits a double gearing which transmits the power in two lines—one from each end of the same shaft, thus insuring perfect alignment and reducing all friction and side strain to a minimum.

Write
for
Catalogue
and
Prices



F. E. MYERS & BRO., ASHLAND, OHIO
ASHLAND PUMP AND HAY TOOL WORKS

Make Your Customers Comfortable

AS a land salesman you appreciate the importance of the first impression of your tract that your prospective customer gets. The ride to the land creates in his mind the first idea of its desirability to him. In a new country the roads are often mere apologies. A slow ride or an uncomfortable ride will make it harder for you to make a sale, while a ride over the same road in an International Auto Wagon produces a good impression and makes the sale easier to close.

International Auto Wagons

are built to ride smoothly and comfortably over country roads. They are giving satisfactory service in many sections where the roads are mere trails. They will take 6 people of average size anywhere that a horse-drawn wagon could go, and will give them a quicker, more comfortable ride.



The illustration above shows an International Auto Wagon climbing Crazy Woman Hill in Johnson County, Wyoming. The International is the first motor-driven vehicle to successfully perform the feat, which proves how well it is designed to operate in new country.

IN addition to being an ideal land salesman's car the International Auto Wagon may be used with profit by farmers and fruit growers for any kind of light hauling. It reduces distance by half. It never tires, but will work for any number of hours at any time. It can be used as a pleasure car as well as for business.

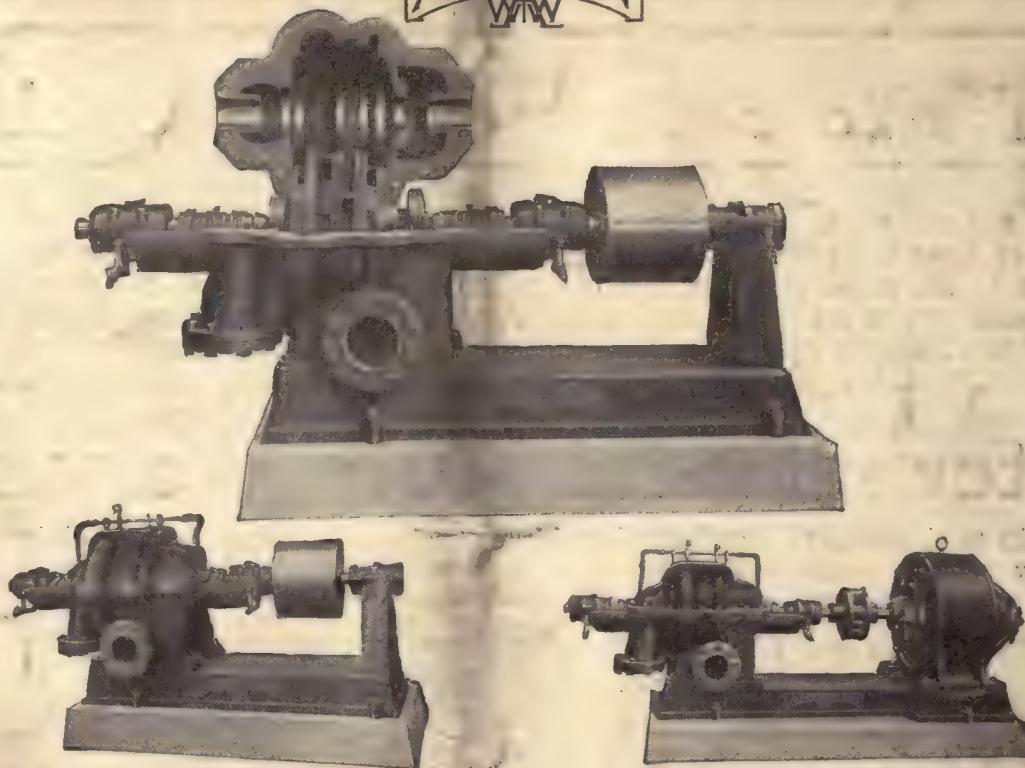
THE engine is simple and powerful, it is air-cooled, no danger of freezing in winter. The drive is positive. The car is unusually strong, built to stand the racking of rough roads. The power is developed at very low fuel cost. The

solid tires eliminate blow-outs, punctures, and other tire troubles, and give good traction in sand or mud. The International Auto Wagon is just the car for you to use when carrying prospective customers to your land.

Let us send you a catalogue and full information about this desirable salesman's car. Its purchase will be a good investment in many ways. A post card will bring you the catalogue. Address the

International Harvester Company of America
Chicago (INCORPORATED) U S A

AMERICAN
WV



If You Will Study The Details of Construction of The "American" Centrifugal You Will See Why No Other Centrifugal Equals Its Efficiency

ALL Volute Centrifugal Pumps look much alike from the outside. It is when you lift the cover and study the details of construction, the material, the adjustments and the workmanship that you see why one centrifugal will only develop 50 per cent efficiency and another 82 per cent.

It is in the refinement of the flow-lines, the rotative and end thrust balance of the impeller, the machining of the impeller and interior of the casing, the adjusting of the impeller in the casing like a watch, the packing and water sealing of the glands and the wide bearings, perfectly babbitted and lubricated with ring oilers from oil cellars that form the marks of quality in a centrifugal.

Take the end thrust bearings in the single suction enclosed runner, "American" Volute Centrifugal as an example:—

It is a well known fact that the intake of water on one side produces an end thrust on the impeller and shaft toward the side opposite to the intake.

In most centrifugals no provision is made to overcome this end thrust while a few have what is termed marine type thrust bearings, which consist of a series of annular rings placed on one end of the shaft and rotating in a recessed casing. These bearings are difficult to keep properly lubricated, are not perfectly water cooled, add to the friction and frequently cause trouble through heating.

The "American" thrust bearings consist of two rotating opposed cupped discs keyed onto the shaft in an extension of the main casing.

The rotating discs are separated by a stationary central sleeve having opposed dished discs at its ends facing the rotating discs with bronze annular ring facings and have highly polished surfaces to produce a perfect bearing.

In operation, these discs are wholly submerged in circulating water and when the end thrust carries the discs sufficiently close together in either direction so that a rotating and a stationary disc are only separated by a film of water, the water contained in the enclosed cupped space is held under pressure and acts as a water cushion against the further end thrust of the shaft in that direction.

There is practically no friction in this balance, since it is always submerged in circulating water it requires no lubrication and it is impossible for it to heat or get out of order.

No other centrifugal has so perfect thrust bearings. Study any detail of the "American" centrifugal and you will find the same matchless construction.

If you are looking for the quality in a centrifugal that will prove cheapest in the end better write for catalog 117, the most complete centrifugal catalog ever issued.

The American Well Works

General Office and Works: Aurora, Ill.
Chicago Office: First National Bank Bldg.

THE IRRIGATION AGE

VOL. XXVII

TITLE REGISTERED U.S. PATENT OFFICE

NO 3

CHICAGO, JANUARY, 1912



Ditch Being Dug with Sloping Banks—An Austin Drainage Excavator Ditch, showing variations in width made with same machine

There is only one machine—the AUSTIN DRAINAGE EXCAVATOR—that will dig a ditch with sloping sides in one operation. There is no other machine that will produce a finished ditch so cheaply. *Send for Catalog "S"*

OUR FULL LINE COMPRISES

The Austin Drainage Excavator
The Austin Levee Builder
The Austin Drag Line Excavator

The Austin Side Hill Ditcher
The Austin Highway Ditcher
The Austin Orange Peel Ditcher

The Austin Rolling Platform Traction Ditcher
The Austin Tile Ditcher
The Austin Stump Puller and Grubber

Any of these machines can be mounted on a float, on wheels, skids, track rail, or rolling platform traction.

F. C. AUSTIN DRAINAGE EXCAVATOR CO.

AGENTS WANTED IN UNOCCUPIED TERRITORY

Railway Exchange
CHICAGO, ILLINOIS

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BALDWINVILLE, N. Y.

Centrifugal Pumping Machinery, designed for any irrigating or dredging proposition. Send details or specifications of what is wanted and we will recommend a pumping outfit to supply the need.

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225-231 North Jefferson St., Chicago
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D. H. ANDERSON, Publisher

CHICAGO, ILLINOIS

Myers Power Pumps

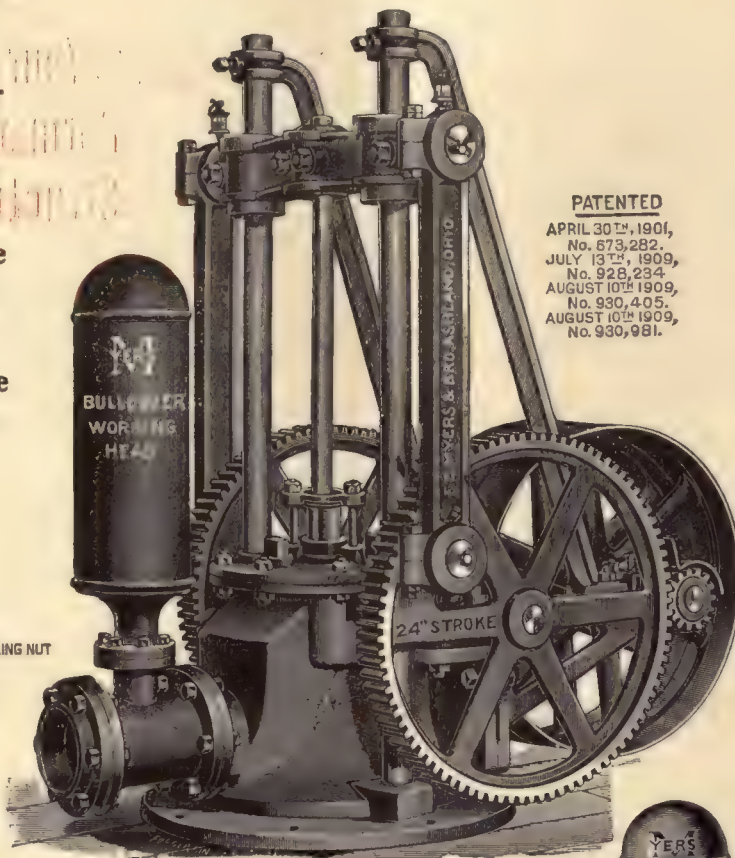
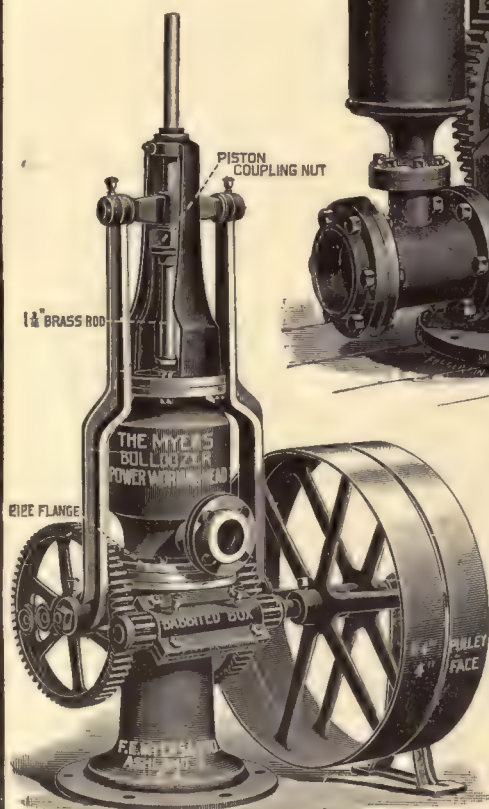
Working Heads, Pumping Jacks, Cylinders, Etc.

PATENTED

The Myers
Bulldozer Power
Working Heads
For Deep Wells

Length of Stroke
5 to 24 inches

Size of Discharge
Up to 6 inches



PATENTED
APRIL 30TH, 1901,
No. 673,282,
JULY 13TH, 1909,
No. 928,234,
AUGUST 10TH, 1909,
No. 930,405,
AUGUST 10TH, 1909,
No. 930,981.

PATENTED

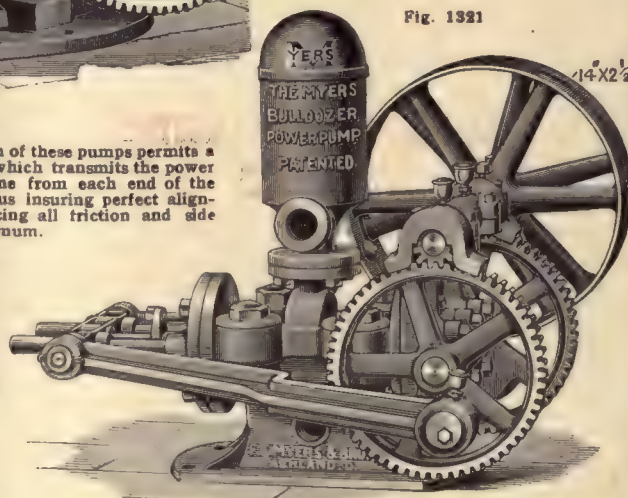
The Myers
Bulldozer
Power Pumps
For
Shallow Wells

Double Acting
Length of
Stroke
5 to 20 inches

Size of
Cylinders
2 1/2 to 6 inches

Size of
Discharge
Up to 4 inches

Capacities
600 to 7200 Gallons
per Hour



The construction of these pumps permits a double gearing which transmits the power in two lines—one from each end of the same shaft, thus insuring perfect alignment and reducing all friction and side strain to a minimum.

Write
for
Catalogue
and
Prices

F. E. MYERS & BRO., ASHLAND, OHIO
ASHLAND PUMP AND HAY TOOL WORKS

Choose Your Market

FRUIT growers and truck farmers often find a shade of difference in prices at different points. It is surely good business to be so equipped as to secure the advantage of that difference for yourself. Using an



INTERNATIONAL AUTO WAGON

to make your deliveries puts you in just that position.

You can travel a hundred miles a day if you want to, and be sure of delivering your load on time as agreed, without increasing the cost of delivery. You can choose your own market, take your produce to the town or place where prices are highest, and be independent of the conditions that force your less fortunate competitor to sell in the nearest market regardless of price advantages.

The ability to choose your own market is only one of many advantages an International Auto Wagon brings to you. It reduces your distance to town by more than half. It can be used for any light hauling. It will work twenty-four hours a day in emergencies. Besides these business advantages, it is easily converted into a pleasure car by the addition of an extra seat and top and will then seat four or five people comfortably. It is a paying investment in many ways, and besides paying its way in your business, will furnish a lot of pleasure to the family.

International Auto Wagons are simple and easy to operate. They are dependable, and very economical. The solid tires eliminate punctures, blowouts, and other tire troubles. The wheels are sufficiently high to provide plenty of road clearance. They will travel over all kinds of roads, winter or summer, through sand or mud.

Let us send you a catalogue and full information about this ideal farmer's car that makes money for its owner. A post card request will do.

INTERNATIONAL HARVESTER COMPANY OF AMERICA

(INCORPORATED)

Chicago

Harvester Building

U S A



“American” Turbine Centrifugals Overcome Difficult Deep Pumping Conditions

IN many large capacity deep wells the water contains so much silt and grit that it quickly destroys the valves in any of the plunger types of pumps and rapidly reduces efficiencies.

The “American” Turbine Centrifugal not only meets these conditions by delivering a large quantity of water from a deep drill hole, but it develops **high** efficiencies and **maintains** its **initial** efficiency under the **most difficult** pumping conditions.

In several of the large irrigation pumping districts in New Mexico, where there are large under stratus of quicksands and where other types of pumps failed completely, the “American” Turbine Centrifugal is maintaining its initial efficiency even under conditions where it is frequently necessary to shovel the pumped sand away from the discharge spout of the pump.

It is this ability to develop a type of centrifugal that will meet nearly every condition, combined with unequalled high efficiencies that has made the “American” Centrifugal the standard wherever this type of pump is used.

“American” Turbine Centrifugals are built in sizes to operate in wells from 12 inches to 30 inches in diameter, inside of casing, produce best results on heads to 150 feet and deliver from 700 to 3,000 gallons of water per minute.

These pumps develop up to 70 per cent efficiencies and are especially adapted for pumping large, deep wells in waterworks, manufacturing plants and for irrigation purposes.

If you have a difficult pumping problem of any kind let us show you why our 43 years experience in building pumps of nearly every type enables us to meet your conditions most successfully and at greatest economy.

American Turbine Centrifugals are described in General Centrifugal Catalog No. 117, the most complete centrifugal pump catalog published. Write for it.



The American Well Works
General Office and Works: Aurora, Ill.
Chicago Office: First National Bank Building



THE IRRIGATION AGE

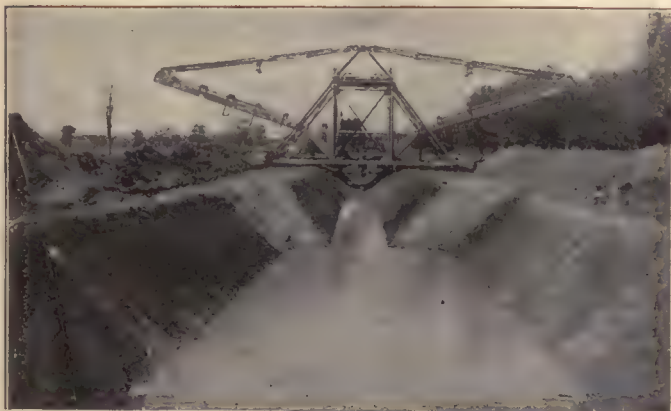
VOL. XXVII

TITLE REGISTERED U.S. PATENT OFFICE

NO 4

CHICAGO, FEBRUARY, 1912

The Tremendous Efficiency of Austin Drainage Excavators



Ditch Being Dug with Sloping Banks—An Austin Drainage Excavator Ditch, showing variations in width made by same machine

is shown by their work in the prairie soils of Illinois and Iowa, where every kind of earth is found—each particularly susceptible to caving from action of frost. To date we have not learned of a single cleanout or repair being made.

By the Austin System all parts of the bank and bottom are true to grade and slope and equally firm, and consequently offer equal resistance to water. This means a *permanent ditch which keeps its shape*, and does not require constant cleaning, deepening and widening.

—OUR FULL LINE COMPRISES—

The Austin Drainage Excavator
The Austin Levee Builder
The Austin Drag Line Excavator
The Austin Side Hill Ditcher

The Austin Highway Ditcher
The Austin Orange Peel Ditcher
The Austin Sewer and Water Works Excavator

The Austin Pipe Line Excavator
The Austin Tile Ditcher
The Austin Stump Puller and Grubber

Any of these machines can be mounted on a float, on wheels, skids, track rails, or rolling platform traction.

F. C. AUSTIN DRAINAGE EXCAVATOR CO.

Railway Exchange
CHICAGO, ILLINOIS

(25 Years practical experience building excavating machinery). Send for Catalogue "S."

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Centrifugal Pumping Machinery, designed for any irrigating or dredging proposition. Send details or specifications of what is wanted and we will recommend a pumping outfit to supply the need.

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D. H. ANDERSON, Publisher
CHICAGO, ILLINOIS

Myers Power Pumps

Working Heads, Pumping Jacks, Cylinders, Etc.

PATENTED

The Myers
Bulldozer Power
Working Heads
For Deep Wells

Length of Stroke
5 to 24 inches

Size of Discharge
Up to 6 inches

PATENTED

The Myers
Bulldozer
Power Pumps
For
Shallow Wells

Double Acting
Length of
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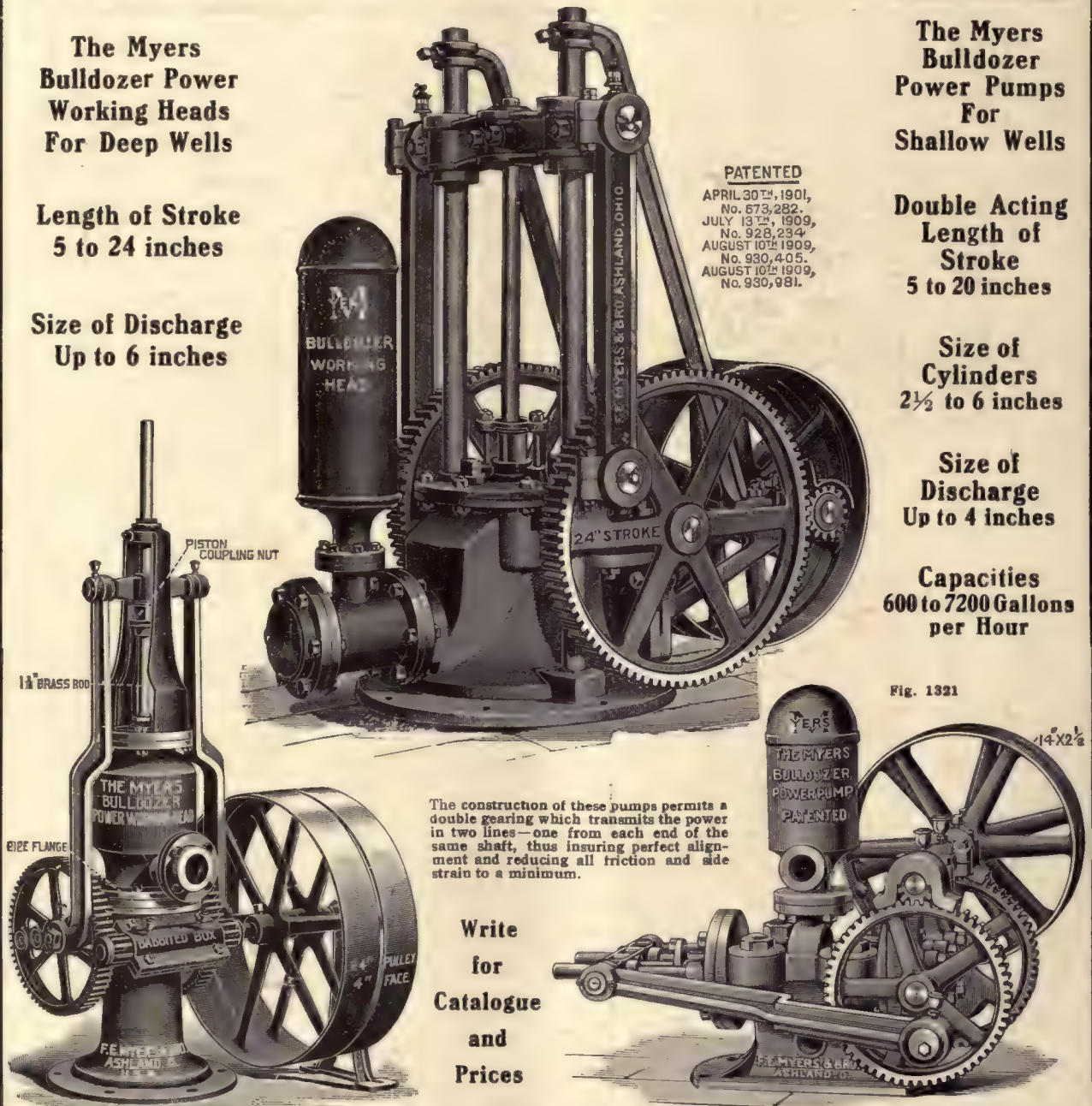
Size of
Cylinders
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Size of
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Capacities
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APRIL 30TH, 1901,
No. 673,282.
JULY 13TH, 1909,
No. 928,234
AUGUST 10TH 1909,
No. 930,405.
AUGUST 10TH 1909,
No. 930,981.



The construction of these pumps permits a double gearing which transmits the power in two lines—one from each end of the same shaft, thus insuring perfect alignment and reducing all friction and side strain to a minimum.

Write
for
Catalogue
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Prices

F. E. MYERS & BRO., ASHLAND, OHIO
ASHLAND PUMP AND HAY TOOL WORKS

The International Auto Wagon



Quick Deliveries at Less Expense

To deliver fruit, vegetables or any other produce to your shipping point or to your customers with a motor wagon is advantageous in many ways.

FIRST—It saves time—that's important during the busy season.

SECOND—Your produce is delivered in much better condition—that means a better price.

THIRD—Your busy season lasts only a short time. Nevertheless, if you deliver with horses, you must care for them and feed them the year round.

Besides saving time and enabling you to make quick deliveries, the International auto wagon will show an actual saving over the cost of hauling with horse and wagon equipment. It will save you money the year round.

With the addition of an extra seat and top, the International auto wagon is converted into a comfortable and roomy vehicle for the use of the entire family—it is the ideal car for both business and pleasure.

All we ask is an opportunity to demonstrate to you that the International auto wagon is a time and money saver. A post card will bring catalog and full information.



International Harvester Company of America
705 Harvester Building (INCORPORATED) Chicago U S A



This Mark on a Deep Well Pump

is the stamp of distinction that represents the quality, the reliability, and the experience in pump making that for over 40 years has characterized and made standard among this type of pumps the

"American" Deep Well Pump

The water cylinders are made entirely of bronze, in both Single-acting and Double-acting styles, so designed that all valves can be drawn from the well with the plunger rods, without disturbing the pipe connections, and the Double-acting cylinders deliver full plunger displacement capacity, both on the *Down-stroke* and the *Up-stroke*.

"American" Deep Well Pumps are equipped with steam heads, with pump-jacks for belt power or directly geared to electric motors.

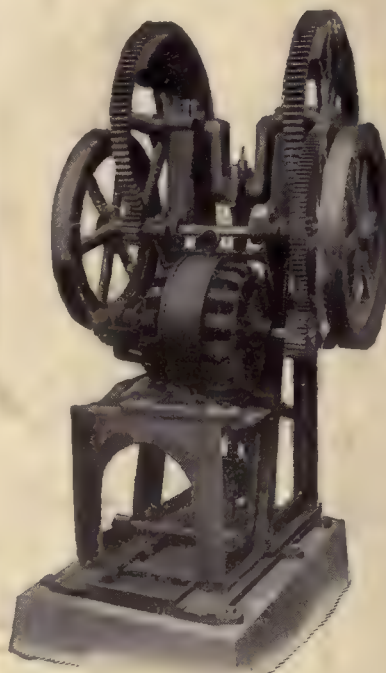
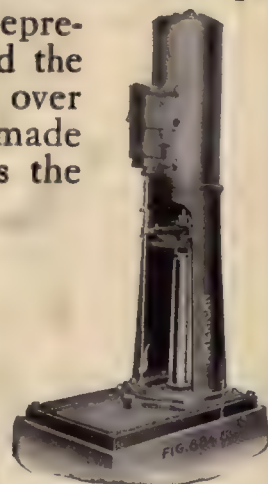
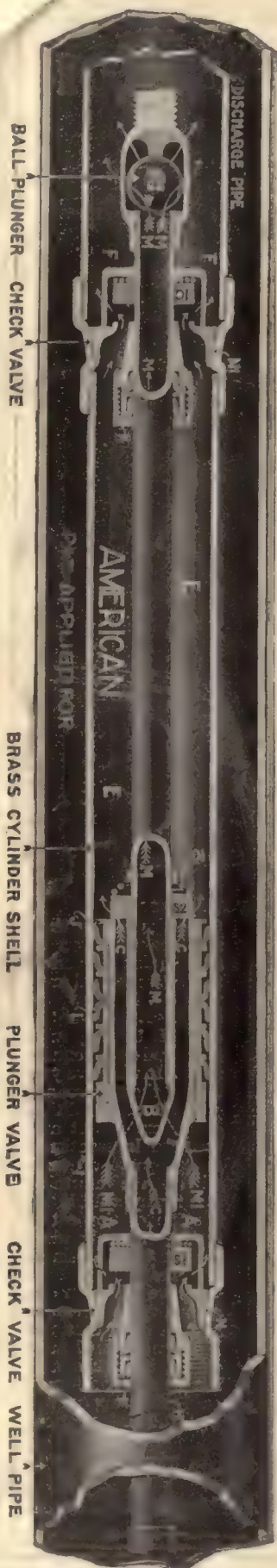
They are made in any size to the largest built and the deepest wells in the world are pumped by them.

They are characterized by their simple, sturdy designs, the superior material used in their construction, and the careful machining and perfect adjustment of every working part.

*They are described in
Deep Well Catalog No.
110. Write for it.*

The American Well Works

General Office and Works: Aurora, Ill., U.S.A.
Chicago Office: First National Bank Building



THE IRRIGATION AGE

VOL. XXVII

TITLE REGISTERED U.S. PATENT OFFICE

NO 5

CHICAGO, MARCH, 1912

The Cost of Excavating a Sloped Ditch

is no greater than the cost of excavating a ditch with ragged banks, if an Austin (Improved) Drainage



Improved Austin Drainage Excavator

Excavator is used. This is an immense advantage, since the ditch with sloped sides is distinctly superior to one with ragged sides. Its capacity is greater for any size; it is less liable to scour and to formation of bars; its banks do not cave into the channel; it costs less to maintain; it is more presentable. These are all admitted facts. In the past, however, they have been overshadowed by the greater fact that sloped ditches cost more to construct. The Austin (Improved) Drainage Excavator changes this last condition absolutely. A contractor with a dredge has no advantage over another contractor with a dredge, but a contractor with an Austin Drainage Excavator has a great advantage over another contractor with a dredge.

Other advantages are explained in Catalogue "S"—Ask for it.

F. C. AUSTIN DRAINAGE EXCAVATOR CO.

Railway Exchange
CHICAGO, ILLINOIS

(25 Years practical experience building excavating machinery.)

MORRIS MACHINE WORKS

BALDWINVILLE, N. Y.

Centrifugal Pumping Machinery, designed for any irrigating or dredging proposition. Send details or specifications of what is wanted and we will recommend a pumping outfit to supply the need.

New York Office, 39-41 Cortlandt Street
HENION & HUBBELL, : : General Agents
223-231 North Jefferson St., Chicago
HARRON, RICKARD & McCOMB, : Agents
San Francisco and Los Angeles, Cal.
H. A. PAINF, Agent, : : : Houston, Texas



D. H. ANDERSON, Publisher
CHICAGO, ILLINOIS

Myers Power Pumps

Working Heads, Pumping Jacks, Cylinders, Etc.

PATENTED

The Myers
Bulldozer Power
Working Heads
For Deep Wells

Length of Stroke
5 to 24 inches

Size of Discharge
Up to 6 inches

PATENTED

The Myers
Bulldozer
Power Pumps
For
Shallow Wells

Double Acting
Length of
Stroke
5 to 20 inches

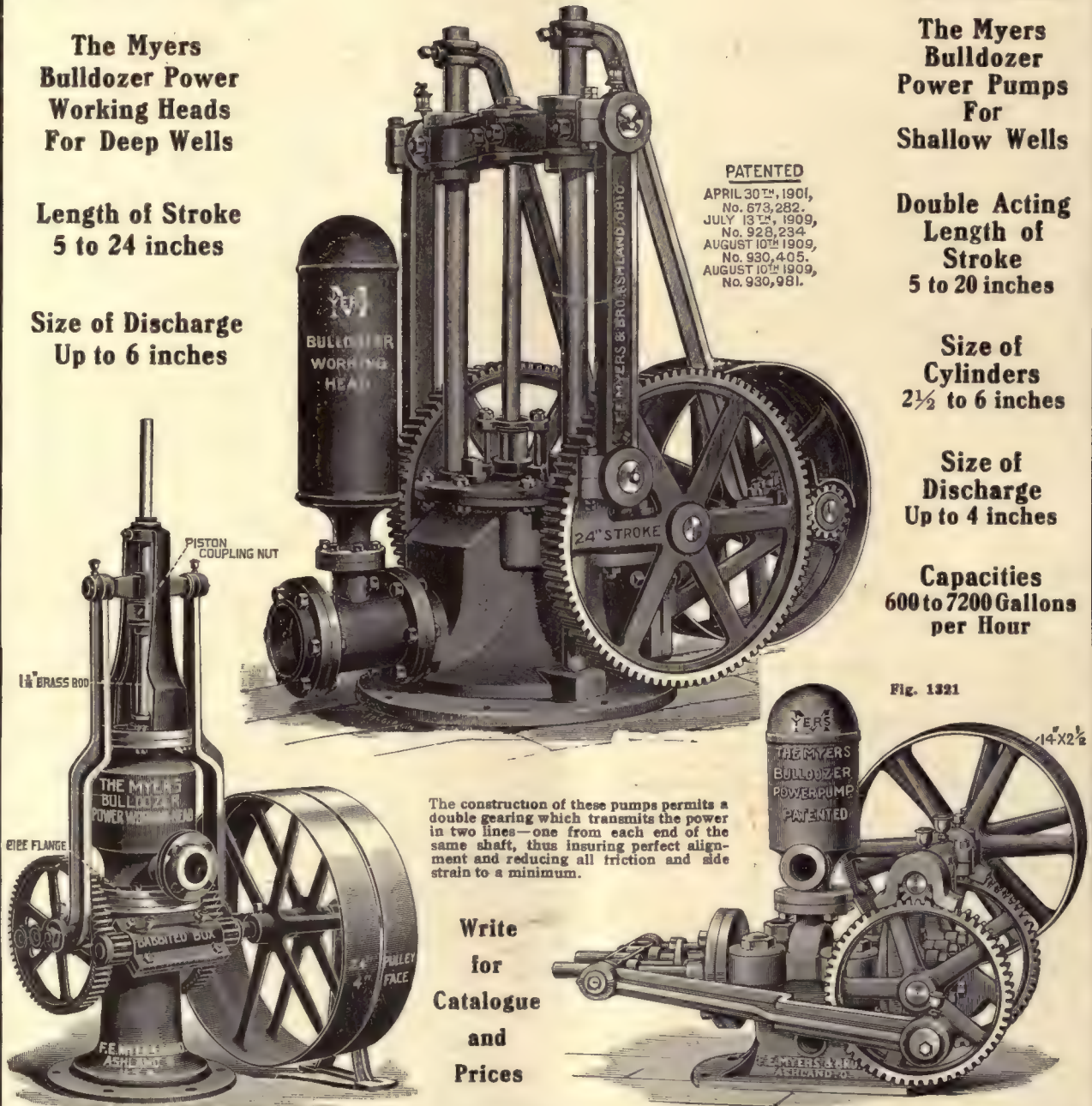
Size of
Cylinders
2½ to 6 inches

Size of
Discharge
Up to 4 inches

Capacities
600 to 7200 Gallons
per Hour

PATENTED

APRIL 30TH, 1901,
No. 673,282,
JULY 13TH, 1909,
No. 928,234,
AUGUST 10TH 1909,
No. 930,405,
AUGUST 10TH 1909,
No. 930,981.



The construction of these pumps permits a double gearing which transmits the power in two lines—one from each end of the same shaft, thus insuring perfect alignment and reducing all friction and side strain to a minimum.

Write
for
Catalogue
and
Prices

F. E. MYERS & BRO., ASHLAND, OHIO
ASHLAND PUMP AND HAY TOOL WORKS

The International Auto Wagon



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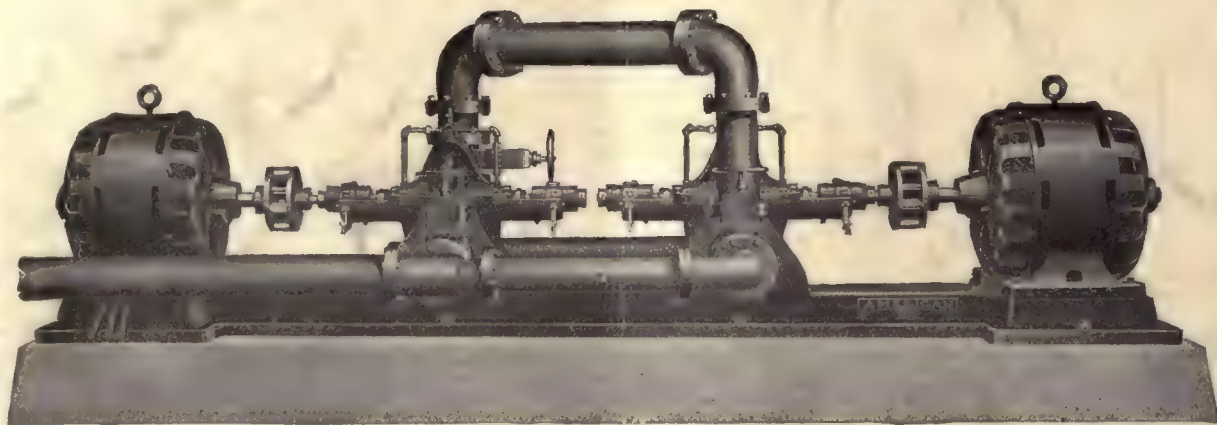
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International Harvester Company of America
705 Harvester Building (INCORPORATED) Chicago U S A



Why The American Centrifugal Is More Economical Than Any Compound Plunger Pump Yet Devised As A Waterworks Pump



IF YOU were to install an American Centrifugal Waterworks Plant of 100,000,000 gallons daily capacity there would be no more equipment than is shown in the above illustration; you would require only the simple foundations illustrated and a very small building to house the pumps and either or both of the pumps can be used independently as single stage pumps delivering water against 45 lbs. pressure or by merely closing two valves and opening another, they can be combined into a two stage fire pressure pump, delivering water against 90 lbs. pressure.

It's a remarkable thing that in making a comparison between centrifugal pumps and plunger pumps in water works installations in recent articles appearing in engineering journals, advocates of the latter type of pump have figured the efficiency of the plunger pump at 91.5 per cent, and the centrifugal at 65 per cent, and in not a single instance has been considered the additional expense and greater interest on the investment of the far more expensive foundations and much larger housing required for the plunger pumps.

American centrifugals develop up to 82 per cent efficiencies, instead of 65 per cent, and since they have no valves to wear out, they maintain practically their original efficiencies, whereas the average efficiency of a plunger pump is nearly always far below its rated efficiency.

Only one man on each watch is required to attend a 100,000,000-gallon daily capacity water works plant of American centrifugals, as compared with three to five for the same plant composed of plunger pumps.

Owing to the exceptionally simple designs of American Centrifugals, there is practically nothing to get out of order, with the result that few repairs are required as compared with the frequent shut downs and expensive repairs required with complicated plunger pumps.

Here are the costs that must be considered to determine the relative economy of these types of pumps as they are and not as they have been figured by advocates of plunger pumps.

Two to five times the ground area required for the plunger pumps.

Two to five times the expense for housing the plunger pumps.

Two to five times the expense for foundations for the plunger pumps.

Two to five times the initial cost for the plunger pumps.

Two to five times the expense for attendance for the plunger pumps.

Two to five times the cost for repairs for the plunger pumps.

Two to five times the pumping time lost in making repairs to the plunger pumps.

Interest charged against this entire greater investment, including ground, buildings and foundations instead of the pump alone as is now the usual custom.

And then compare the 10 to 15 per cent greater efficiency of the best plunger pumps, which is the actual efficiency developed greater than the American Centrifugals, instead of 25 to 30 per cent, which is the claimed greater efficiency of the best compound triple expansion plunger pumps, and it must be evident to any unbiased mind that no plunger pump yet devised will equal the actual economy of the American Centrifugal.

If you are interested in this greater economy write for General Centrifugal Catalog No. 117, the most complete centrifugal pump catalog published.

The American Well Works

General Office and Works: Aurora, Ill.
Chicago Office: First National Bank Building



THE IRRIGATION AGE

VOL. XXVII

TITLE REGISTERED U.S. PATENT OFFICE

NO 6

CHICAGO, APRIL, 1912

The Improved Austin Drainage Excavator



DIGS to templet a ditch with sloping sides. The bucket is double acting, taking a cut both right and left, and will dump at any point on either bank. Frame mounted on multipedal rolling platform tractions which absolutely prevent miring. Travels by own power, laying own track ahead. Templet raised and lowered by cables which absolutely prevent binding. Cuts banks and bottom smooth and true to grade, ready for concrete lining without trimming or shaping.

Full description of the "AUSTIN LINE" of excavating machinery given in Catalogue "S"

F. C. Austin Drainage Excavator Co., Railway Exchange
CHICAGO, ILL.

MORRIS MACHINE WORKS

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D. H. ANDERSON, Publisher
CHICAGO, ILLINOIS

Myers Power Pumps

Working Heads, Pumping Jacks, Cylinders, Etc.

PATENTED

The Myers
Bulldozer Power
Working Heads
For Deep Wells

Length of Stroke
5 to 24 inches

Size of Discharge
Up to 6 inches

PATENTED

The Myers
Bulldozer
Power Pumps
For
Shallow Wells

Double Acting
Length of
Stroke
5 to 20 inches

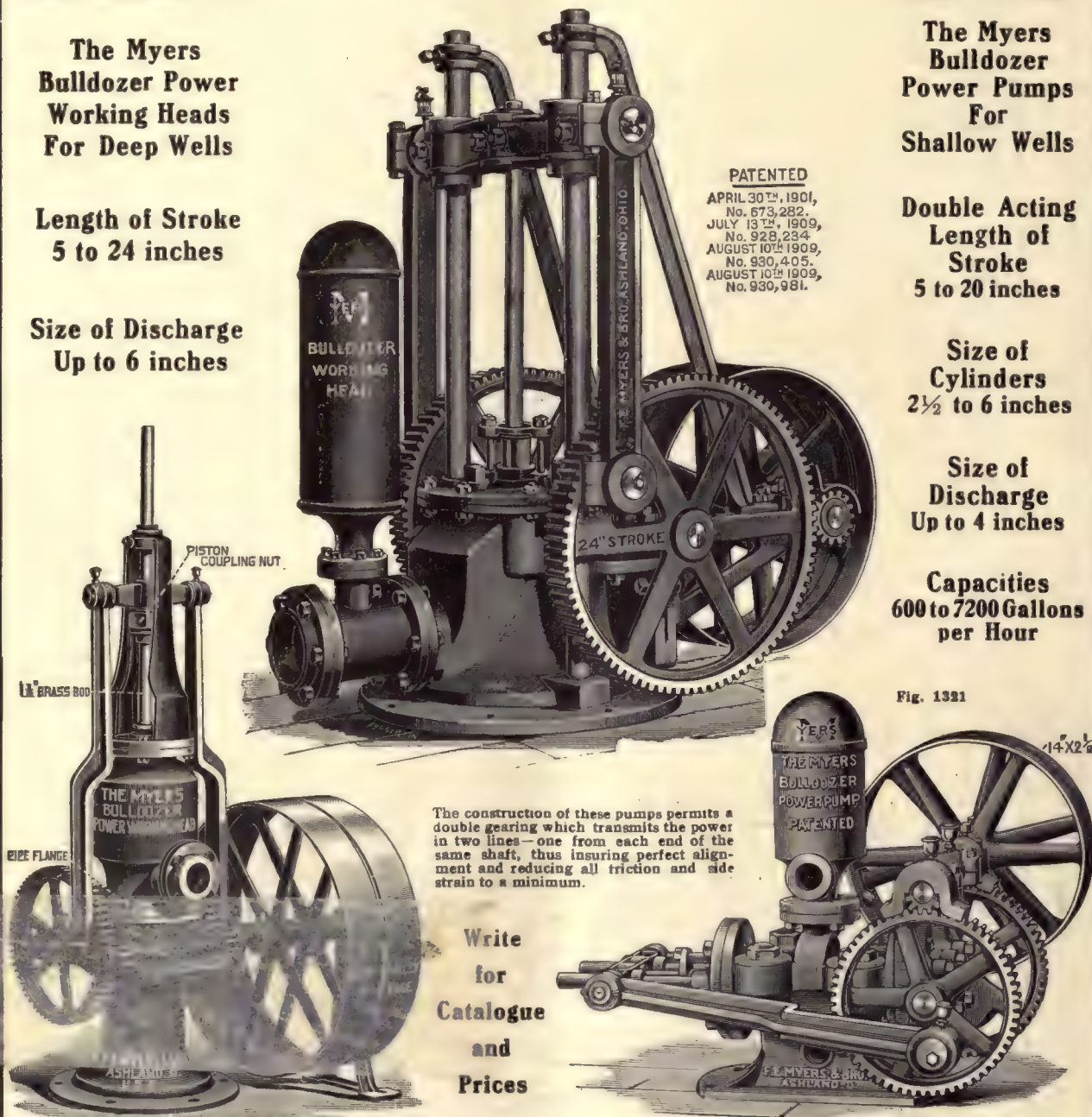
Size of
Cylinders
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Size of
Discharge
Up to 4 inches

Capacities
600 to 7200 Gallons
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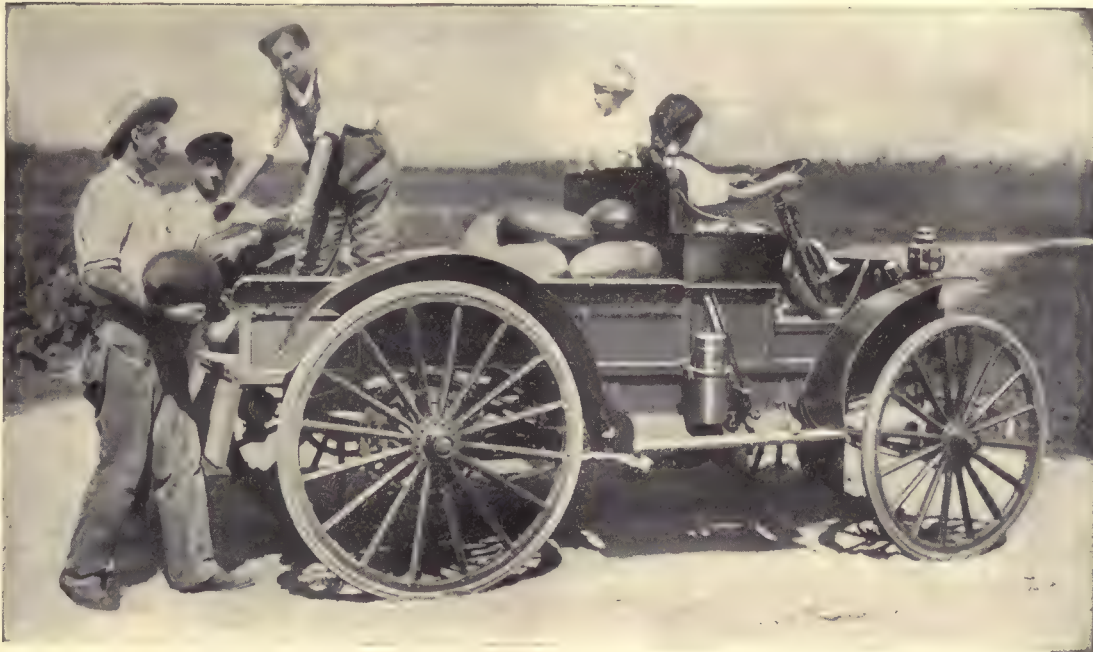


The construction of these pumps permits a double gearing which transmits the power in two lines—one from each end of the same shaft, thus insuring perfect alignment and reducing all friction and side strain to a minimum.

Write
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Catalogue
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Prices

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International Harvester Company of America
705 Harvester Building (INCORPORATED) Chicago U S A



A Larger Quantity of Water From A Deep Drill-Hole

than is produced by any other kind of pump except the Air-Lift and the Air-Lift will require a much larger quantity of power for the same amount of water is delivered by the

"American" Turbine Centrifugal

IT adapts the centrifugal principle of pumping to conditions where no other type of centrifugal can be successfully used.

Sand or silt which rapidly destroy the valves in any of the plunger types of pumps do not materially affect the capacity or efficiency of this pump.

Since there are no valves to wear out this pump maintains practically its original efficiency.

The submerged bearings are kept perfectly lubricated by an improved oiling device which conveys oil from the surface and there is practically nothing to get out of order as there are no moving parts in the well except the impellers keyed to the main shaft.

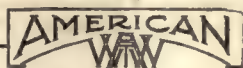
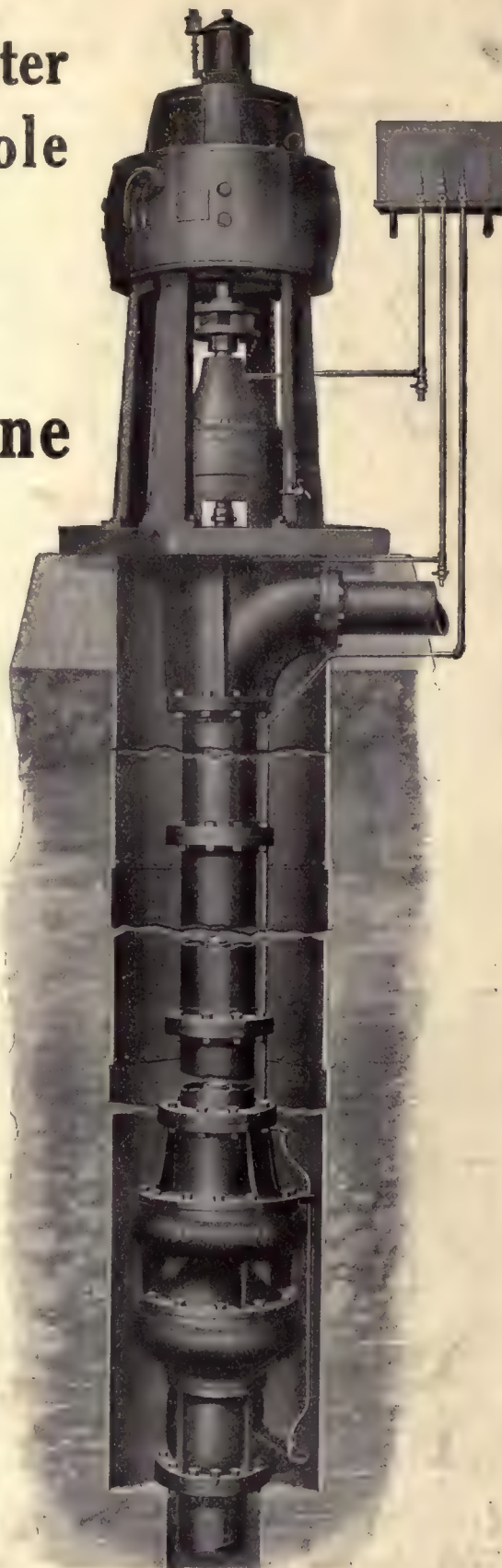
"American" Turbine Centrifugals are made in sizes to operate in wells 12 to 30 inches in diameter, inside of casing, produce best results on heads to 200 feet and deliver from 700 to 3,000 gallons of water per minute.

These pumps develop up to 70 per cent efficiencies and are especially adapted for pumping large, deep wells in water-works, manufacturing plants and for irrigation purposes.

"American" Turbine Centrifugals are described in Catalog No. 117, the most complete centrifugal pump catalog published. Write for a copy today.

The American Well Works

General Office and Works: Aurora, Ill.
Chicago Office: First Nat'l Bank Bldg.



THE IRRIGATION AGE

VOL. XXVII

TITLE REGISTERED U.S. PATENT OFFICE

No 7

CHICAGO, MAY, 1912

A Principle of Successful Contracting



Improved Austin Drainage Excavator

is to use not merely a machine but the best machine. In earlier days when machine ditching was rare a contractor equipped with any good machine had the advantage. Today when machine ditching is universal only the contractor with the best machine has the advantage.

A contractor with a dredge has no advantage over another contractor with a dredge, but a contractor with an **Austin Drainage Excavator** has a great advantage over another contractor with a dredge.

FULL DETAILS ARE GIVEN IN CATALOG "S."

F. C. Austin Drainage Excavator Company

AGENTS WANTED IN OPEN TERRITORY

Railway Exchange, CHICAGO, ILL.



Morris Machine Works

BALDWINVILLE, N. Y.

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Bulldozer Power
Working Heads
For Deep Wells

Length of Stroke
5 to 24 inches

Size of Discharge
Up to 6 inches

PATENTED

The Myers
Bulldozer
Power Pumps
For
Shallow Wells

Double Acting
Length of
Stroke
5 to 20 inches

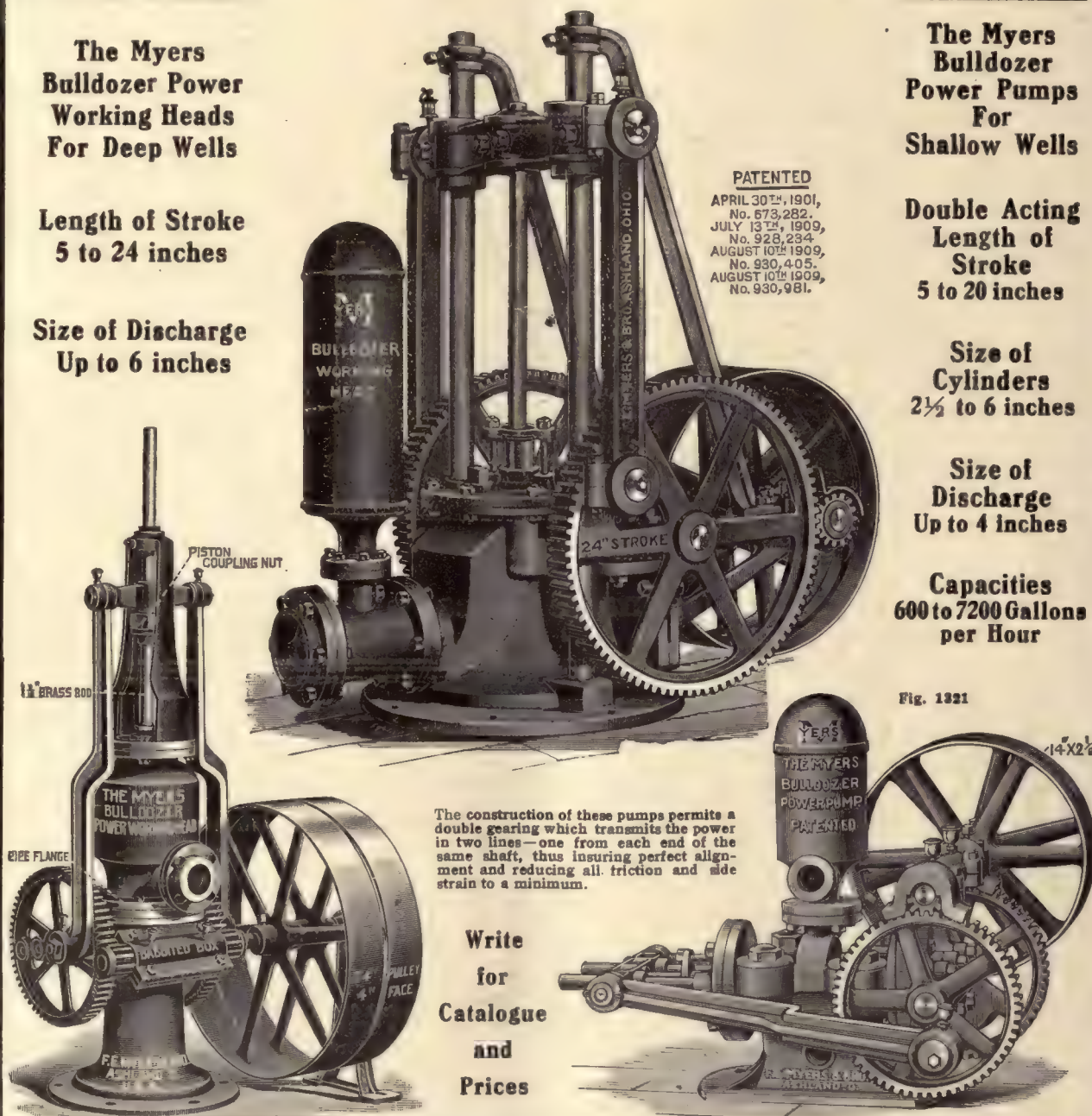
Size of
Cylinders
2½ to 6 inches

Size of
Discharge
Up to 4 inches

Capacities
600 to 7200 Gallons
per Hour

PATENTED

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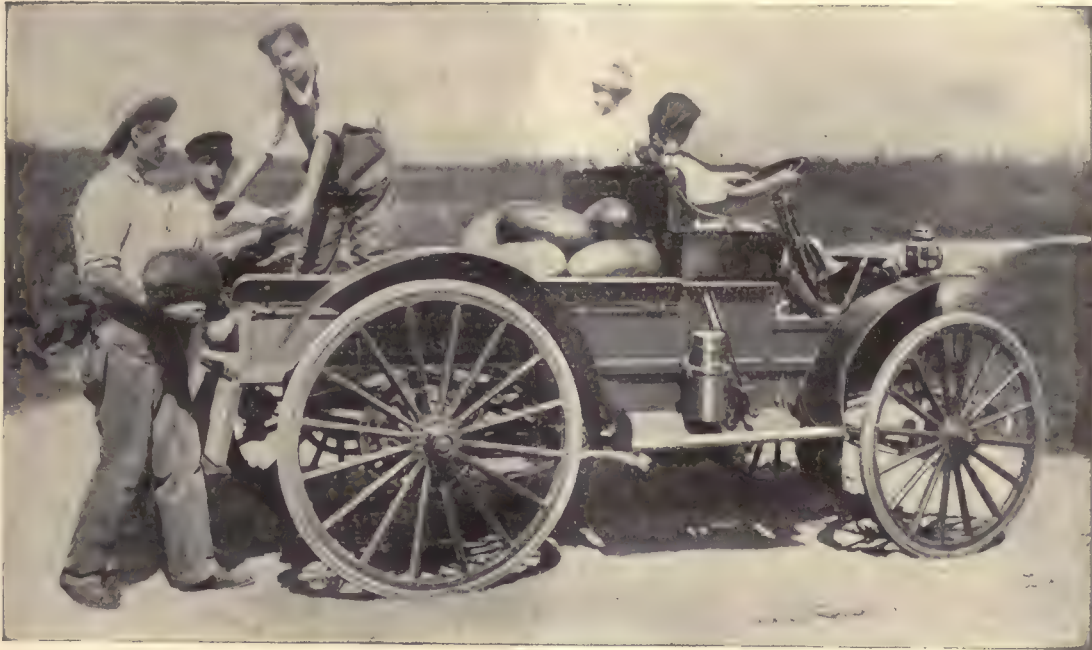


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International Harvester Company of America
705 Harvester Building (INCORPORATED) Chicago U S A



The Cheapest Pump When You Consider All the Costs

Pump efficiency means nothing to the inquiring mind unless all costs necessary to *obtain and maintain* that efficiency are considered.

It's the man with the ability to include *all* costs in his estimate: first cost, foundation cost, housing cost, attendance cost, repair cost, pumping time lost cost, and the *average* efficiency maintained as compared with the total duty done, and who figures interest on the investment to include *foundations, ground and buildings*; who recognizes the greater economy of the

"American" Centrifugal Pump

Two to five times the first cost, two to five times the foundation cost, two to five times the ground cost, two to five times the housing cost, two to five times the attendance cost, two to five times the repair cost and an efficiency that in average use is nearly always far below rated efficiency, due to wear in the valves, are points advocates of old style plunger pumps like to ignore.

American Centrifugals attain up to 82 per cent efficiencies and they not only *attain* them but *maintain* them.

Moreover, they meet practically all pumping conditions larger than a 10-inch deep drill-hole.

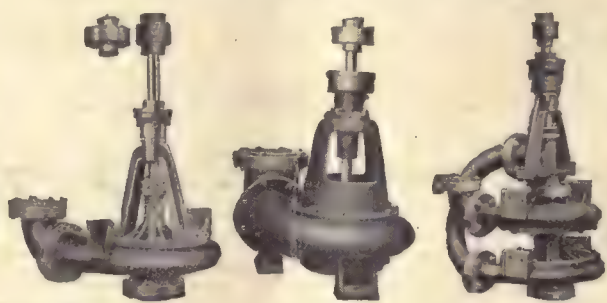
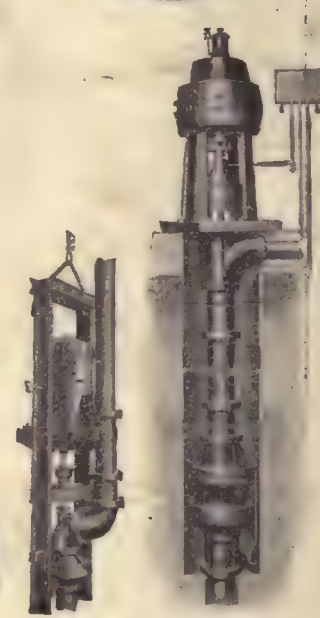
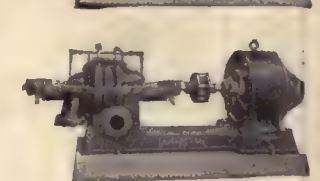
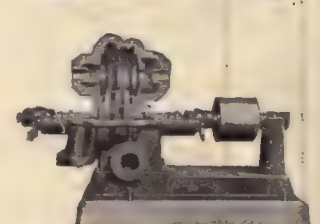
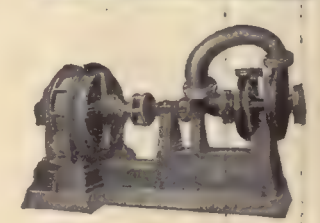
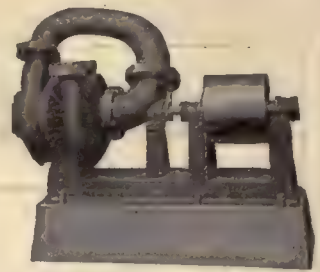
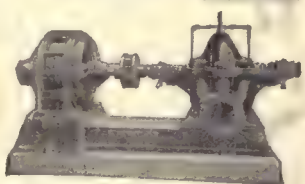
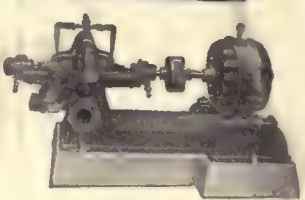
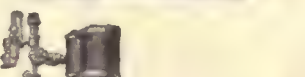
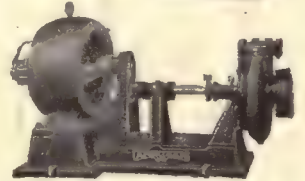
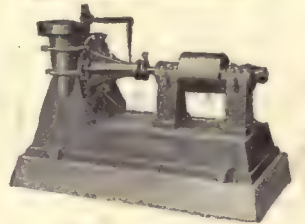
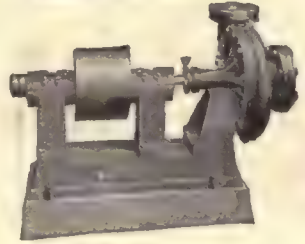
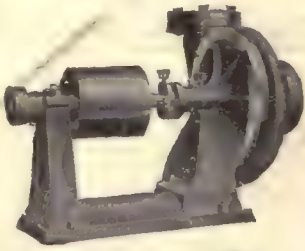
The reason is that no matter what the pumping conditions may be we have a special type of centrifugal especially designed to meet the requirements and as an evidence of it we show just a few of our standard types of centrifugals on this page.

And don't imagine that "American" Centrifugals are *low head* pumps. Nearly any of our standard types of centrifugals, in medium or large sizes, will maintain their maximum efficiencies as single stage pumps when operating against 125-feet heads with an equal increase in head for each additional stage.

If this all-the-cost economy interests you sit down right now and write for catalog 117, the most complete centrifugal pump catalog published.

The American Well Works

General Office and Works: Aurora, Ill., U.S.A.
Chicago Office: First National Bank Building



55
THE

IRRIGATION AGE

VOL. XXVII

TITLE REGISTERED U.S. PATENT OFFICE

No 8

CHICAGO, JUNE, 1912

We Specialize in Ditching Machinery



both for open ditches and pipe line work. These various machines are known to contractors as the "AUSTIN LINE," manufactured by the F. C. AUSTIN DRAINAGE EXCAVATOR CO., comprising the following:

Drainage Excavator—Type A
Drainage Excavator—Type B
Drainage Excavator—Type R
Levee Builder
Drag Line Excavator
Special Wheel Ditcher
Side Hill Ditcher
Highway Ditcher
Orange Peel Ditcher
Pipe Line Excavator
Farm Tile Ditcher

Austin Sewer and Water-works Excavator

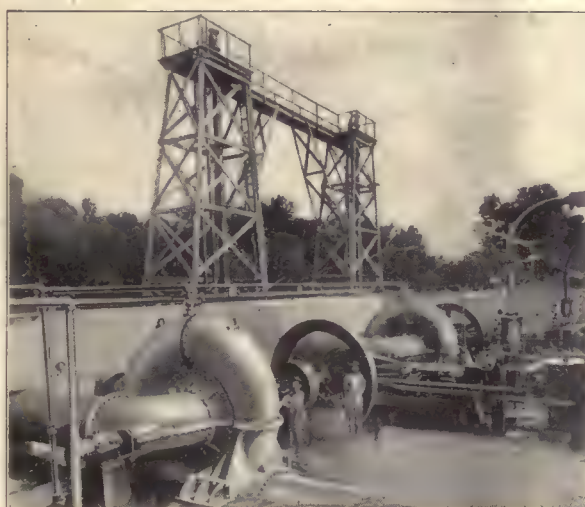
Austin Combination Sloping or Vertical Bank Excavator

Send for Catalogue "S" and Circular No. 200

F. C. Austin Drainage Excavator Company

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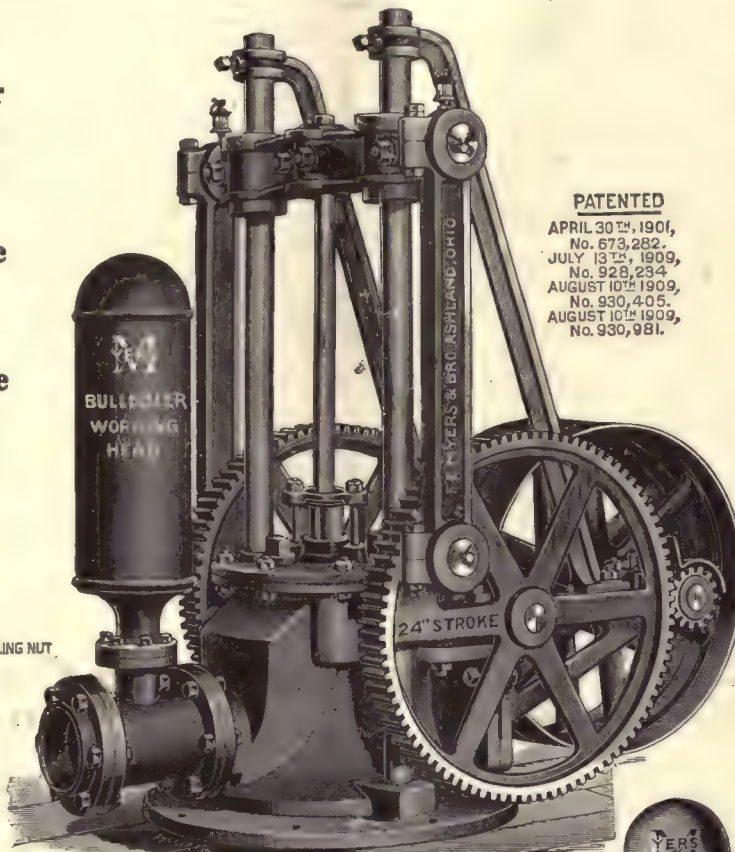
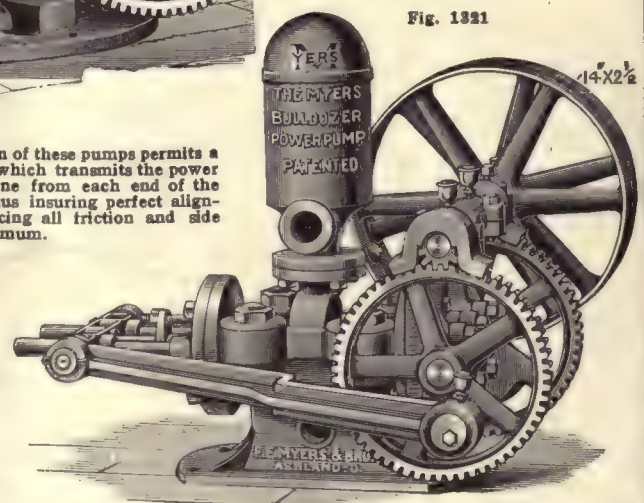
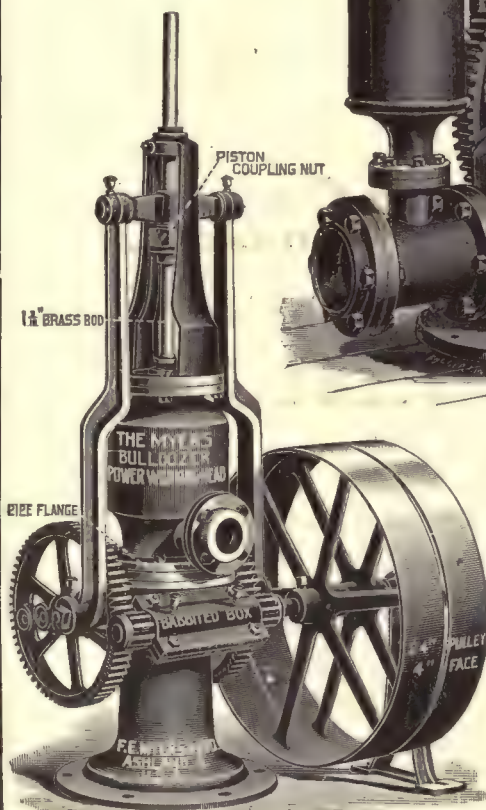


Fig. 1321

The construction of these pumps permits a double gearing which transmits the power in two lines—one from each end of the same shaft, thus insuring perfect alignment and reducing all friction and side strain to a minimum.

Write
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Prices



F. E. MYERS & BRO., ASHLAND, OHIO
ASHLAND PUMP AND HAY TOOL WORKS

The International Auto Wagon



Quick Deliveries at Less Expense

To deliver fruit, vegetables or any other produce to your shipping point or to your customers with a motor wagon, is advantageous in many ways.

FIRST—It saves time—that's important during the busy season.

SECOND—Your produce is delivered in much better condition—that means a better price.

THIRD—Your busy season lasts only a short time. Nevertheless, if you deliver with horses, you must care for them and feed them the year round.

Besides saving time and enabling you to make quick deliveries, the International auto wagon will show an actual saving over the cost of hauling with horse and wagon equipment. It will save you money the year round.

With the addition of an extra seat and top, the International auto wagon is converted into a comfortable and roomy vehicle for the use of the entire family—it is the ideal car for both business and pleasure.

All we ask is an opportunity to demonstrate to you that the International auto wagon is a time and money saver. A post card will bring catalog and full information.



International Harvester Company of America
705 Harvester Building (INCORPORATED) Chicago U S A



A Larger Quantity of Water From A Deep Drill-Hole

than is produced by any other kind of pump except the Air-Lift and the Air-Lift will require a much larger quantity of power for the same amount of water is delivered by the

"American" Turbine Centrifugal

IT adapts the centrifugal principle of pumping to conditions where no other type of centrifugal can be successfully used.

Sand or silt which rapidly destroy the valves in any of the plunger types of pumps do not materially affect the capacity or efficiency of this pump.

Since there are no valves to wear out this pump maintains practically its original efficiency.

The submerged bearings are kept perfectly lubricated by an improved oiling device which conveys oil from the surface and there is practically nothing to get out of order as there are no moving parts in the well except the impellers keyed to the main shaft.

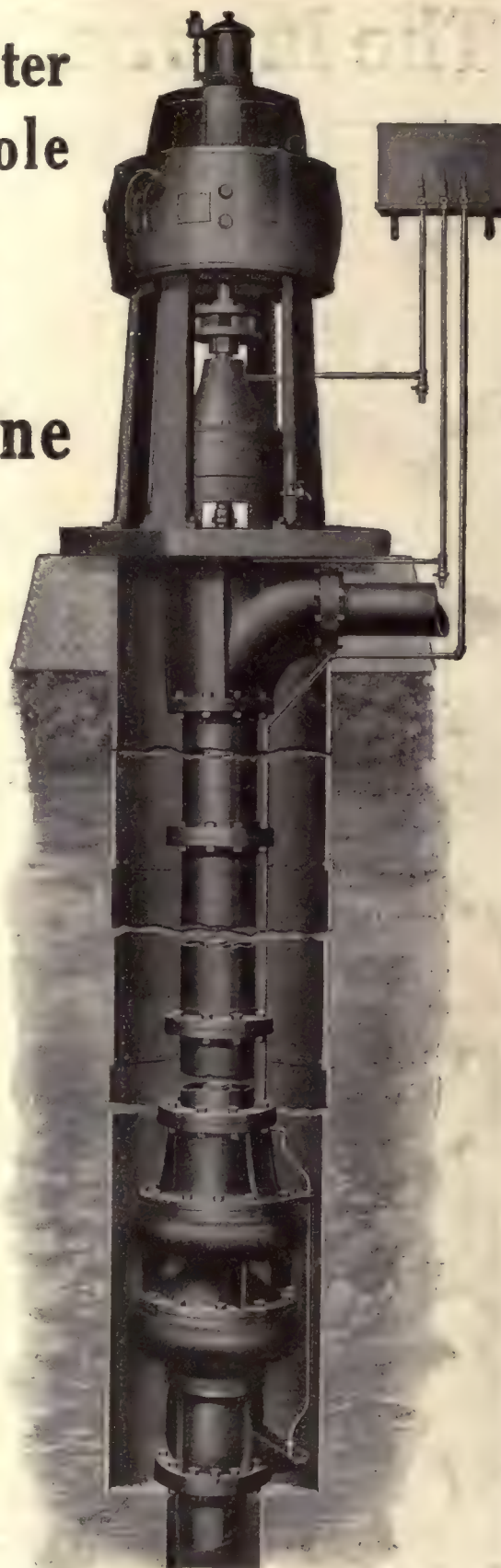
"American" Turbine Centrifugals are made in sizes to operate in wells 12 to 30 inches in diameter, inside of casing, produce best results on heads to 200 feet and deliver from 700 to 3,000 gallons of water per minute.

These pumps develop up to 70 per cent efficiencies and are especially adapted for pumping large, deep wells in water-works, manufacturing plants and for irrigation purposes.

"American" Turbine Centrifugals are described in Catalog No. 117, the most complete centrifugal pump catalog published. Write for a copy today.

The American Well Works

General Office and Works: Aurora, Ill.
Chicago Office: First Nat'l Bank Bldg.



THE IRRIGATION AGE

VOL. XXVII

TITLE REGISTERED U.S. PATENT OFFICE

NO 9

CHICAGO, JULY, 1912

IRRIGATION AND LAND RECLAMATION ARE AMONG THE BIGGEST MODERN PROJECTS. MODERN EXCAVATING METHODS MEAN BIGGEST PROFITS



We specialize in ditching machinery both for open ditches and pipe line work. These various machines are known to contractors as the "AUSTIN LINE," comprising the following:

- Drainage Excavator—Type A
- Drainage Excavator—Type B
- Drainage Excavator—Type R
- Levee Builder
- Drag Line Excavator
- Special Wheel Ditcher
- Side-Hill Ditcher
- Highway Ditcher
- Orange Peel Ditcher
- Pipe Line Excavator
- Farm Tile Ditcher

Austin Sewer and Waterworks Excavator

Austin Combination Sloping or Vertical Bank Excavator
Catalogue "S" covers all details—write

F. C. Austin Drainage Excavator Company

AGENTS WANTED IN OPEN TERRITORY

Railway Exchange, CHICAGO, ILL.



Morris Machine Works

BALDWINVILLE, N. Y.

Centrifugal Pumping Machinery, designed for any irrigating or dredging proposition. Send details or specifications of what is wanted and we will recommend a pumping outfit to supply the need.

New York Office, 39-41 Cortlandt Street
HENION & HUBBELL - - General Agents
223-231 North Jefferson St., Chicago

HARRON, RICKARD & McCOMB - - Agents
San Francisco and Los Angeles, California

H. A. PAINE, Agent - - - Houston, Texas

D. H. ANDERSON, Publisher
CHICAGO, ILLINOIS

Myers Power Pumps

Working Heads, Pumping Jacks, Cylinders, Etc.

PATENTED

The Myers
Bulldozer Power
Working Heads
For Deep Wells

Length of Stroke
5 to 24 inches

Size of Discharge
Up to 6 inches

PATENTED

The Myers
Bulldozer
Power Pumps
For
Shallow Wells

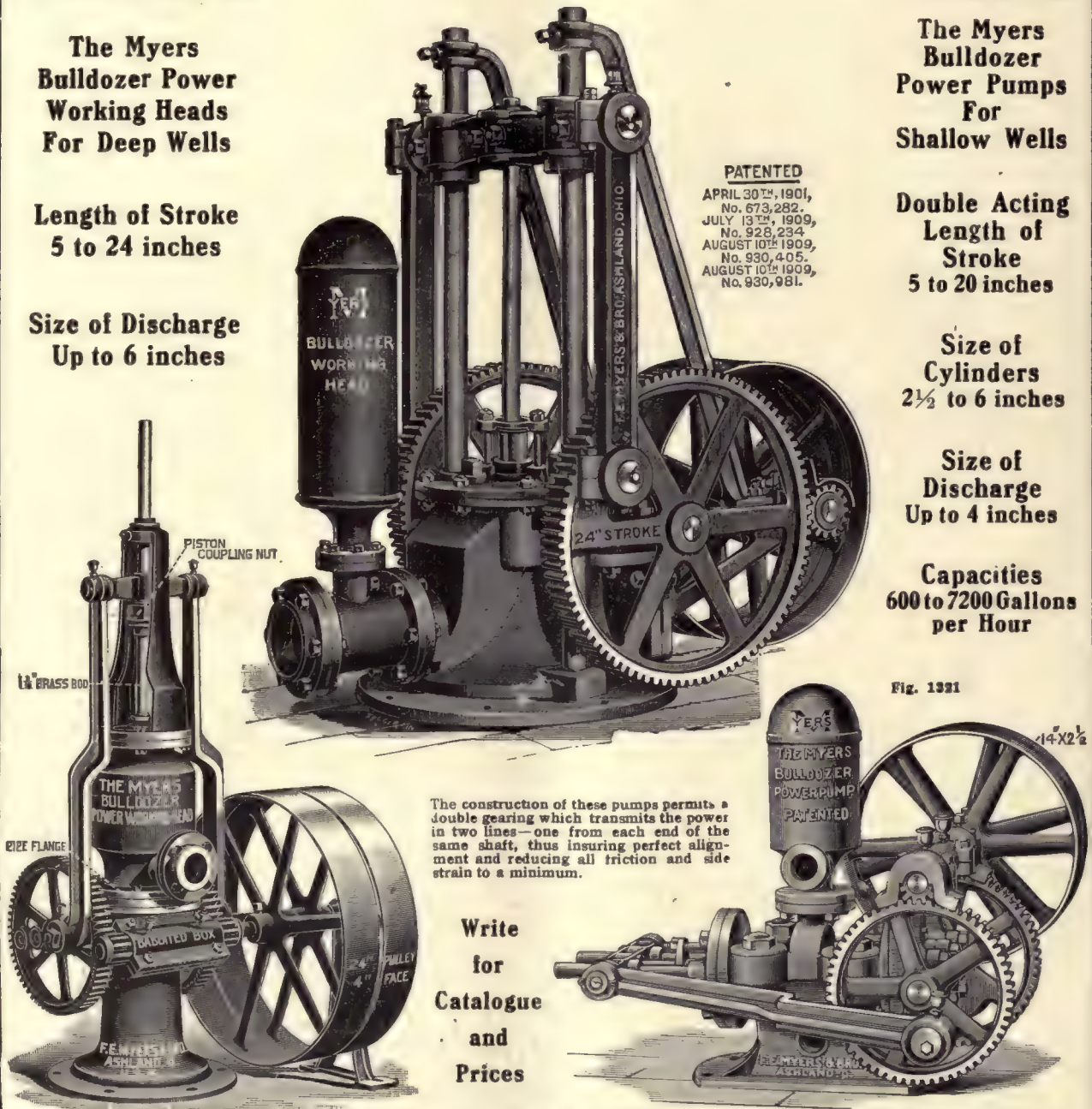
Double Acting
Length of
Stroke
5 to 20 inches

Size of
Cylinders
2½ to 6 inches

Size of
Discharge
Up to 4 inches

Capacities
600 to 7200 Gallons
per Hour

PATENTED
APRIL 30TH, 1901,
No. 673,282.
JULY 13TH, 1909,
No. 928,234.
AUGUST 10TH, 1909,
No. 930,405.
AUGUST 10TH, 1909,
No. 930,981.

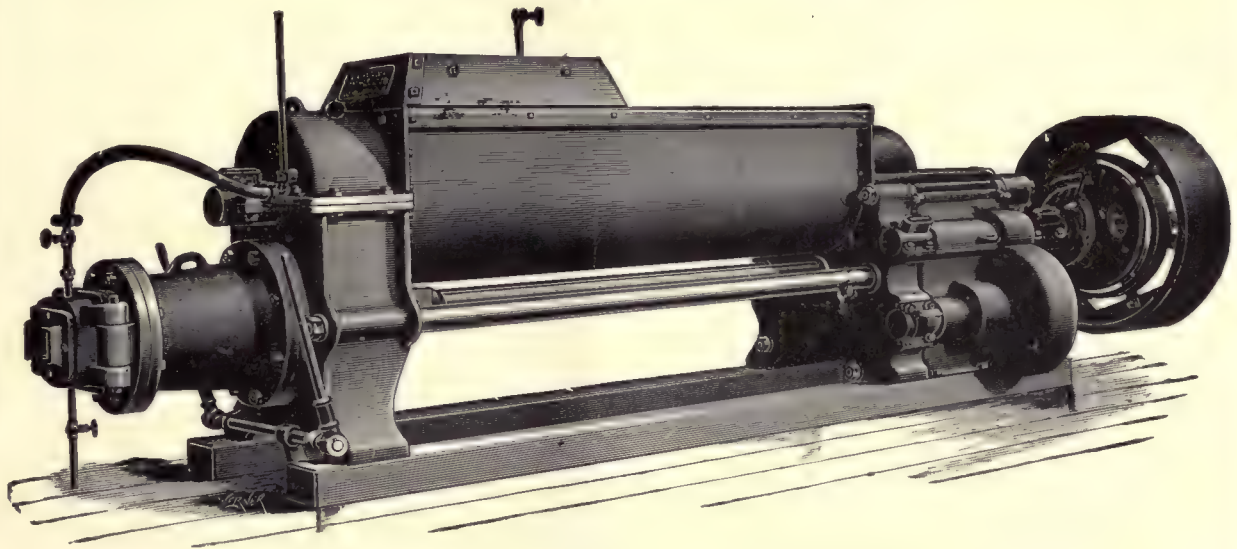


The construction of these pumps permits a double gearing which transmits the power in two lines—one from each end of the same shaft, thus insuring perfect alignment and reducing all friction and side strain to a minimum.

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F. E. MYERS & BRO., ASHLAND, OHIO
ASHLAND PUMP AND HAY TOOL WORKS

UNION MACHINES WITH PUG MILLS COMBINED

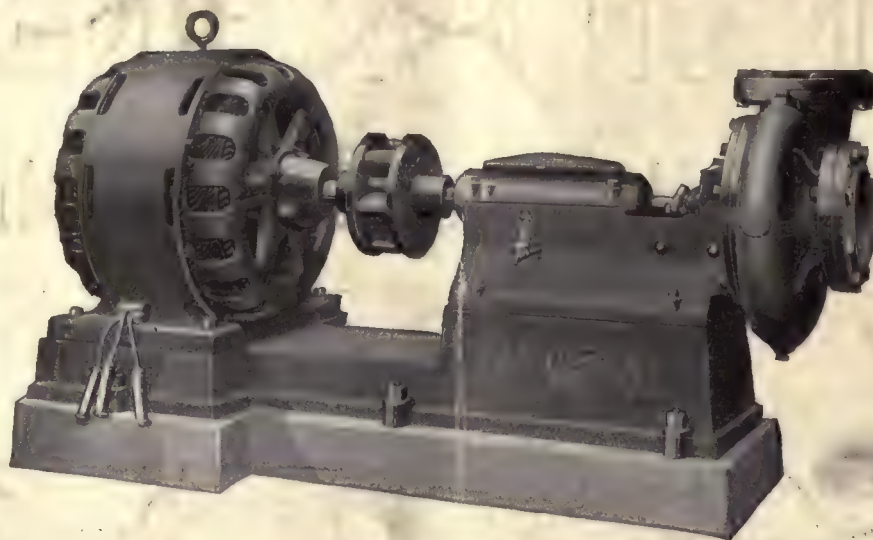


FIVE SIZES ALL CAPACITIES

Outfits for Drain Tile, Hollow Ware, Building
and Paving Brick and other Clay Products

If interested write us for particulars and estimates.

E. M. FREESE & CO.
GALION, OHIO



You Can Solve The Most Difficult Pumping Conditions With “American Centrifugals”

THE reason why American centrifugals are most economical in the widest range of pumping service is that they are designed for special requirements—each type for a specific use—instead of attempting to adapt all conditions to a single style or type of pump.

Here is an illustration of Type P centrifugal which is especially designed for pumping water containing a large amount of sand and grit such as is found in many drainage and irrigation conditions.

In the Type P centrifugal the bearings are made very wide and entirely removed from the volute chamber.

The shaft is carried on a two-ring oiler bearing and the bearing is provided with removable split liners. A roller thrust bearing is placed between the supporting bearings, entirely enclosed from dust and so designed that the rollers dip in oil contained in the oil cellar, maintaining a constant and perfect lubrication.

Perfect alignment is maintained because the end thrust is taken care of entirely within the solid cast bearing.

The gland of the pump is water-sealed and provided with drip pocket so that any leakage is piped to drain without possibility of reaching the bearings.

The great rigidity of this pump, together with its perfect bearings, end thrust balance, and having all bearings removed from the liquid pumped enables it to handle water containing sand and grit more successfully than any other make or type of centrifugal. It is designed for heads up to 125 feet.

If you have any kind of a pumping problem let us show you that we have a pump among our over 50 types of centrifugals which will prove more economical than any other for your requirement. Catalog by first mail on request.

The American Well Works

General Office and Works: Aurora, Ill.

Chicago Office: First National Bank Building

THE IRRIGATION AGE

VOL. XXVII

TITLE REGISTERED U.S. PATENT OFFICE

No 10

CHICAGO, AUGUST, 1912

An Austin Trench Excavator with Bank Sloping Attachment



Can be used for either Tile Ditching, Sewer Trenching, or Digging Open Ditches.

By a simple change the excavator which will dig a tile ditch or sewer trench with vertical sides, becomes an excavator for digging open ditches with sloping sides.

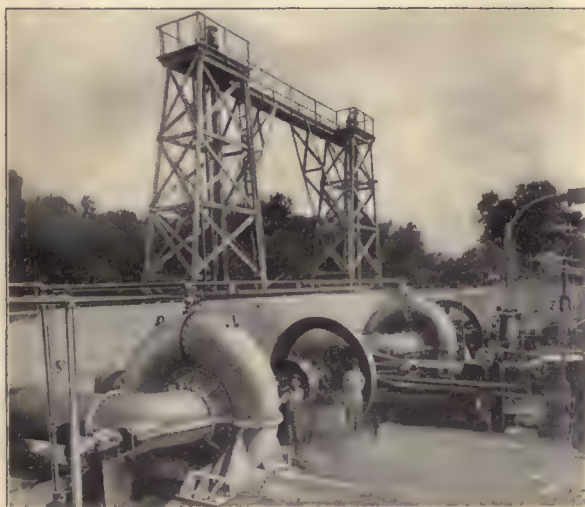
Its all steel construction, with manganese steel working parts, equips it for trenching any material except solid rock. Its positively self-cleaning buckets equip it to dig, without clogging, the stickiest clay and gumbo. Its multipedal rolling platform tractions prevent it from miring in any ground over which a wagon can be driven. It travels over country roads by its own power $1\frac{1}{2}$ miles an hour. It digs sloping bank ditches at a maximum rate of 9 in. ft. per minute. The spoil is deposited on either side of the ditch. Motive power steam or gasoline.

*Send for Catalogue
No. 200*

F. C. Austin Drainage Excavator Company

AGENTS WANTED IN OPEN TERRITORY

Railway Exchange, CHICAGO, ILL.



Morris Machine Works

BALDWINVILLE, N. Y.

Centrifugal Pumping Machinery, designed for any irrigating or dredging proposition. Send details or specifications of what is wanted and we will recommend a pumping outfit to supply the need.

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CHICAGO, ILLINOIS

Myers Power Pumps

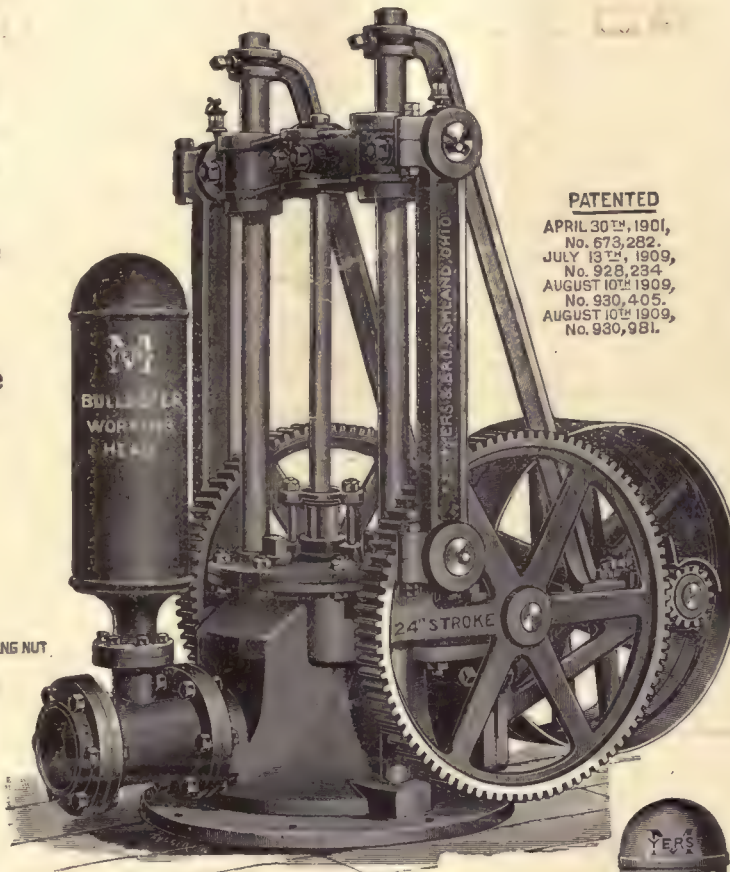
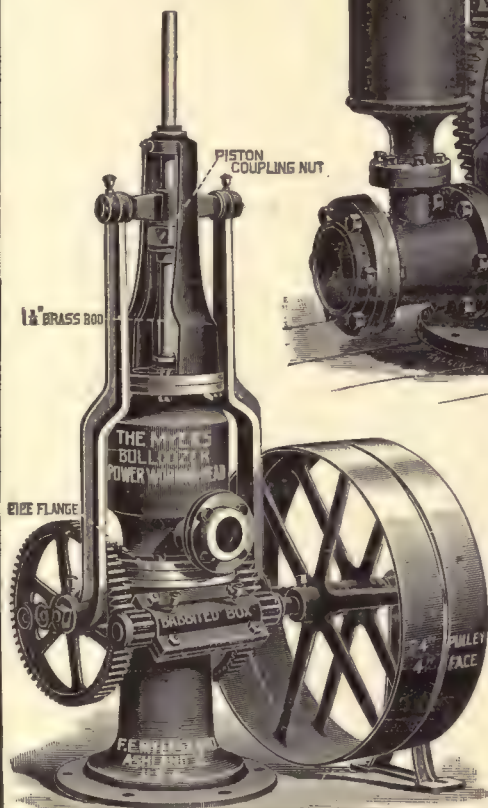
Working Heads, Pumping Jacks, Cylinders, Etc.

PATENTED

The Myers
Bulldozer Power
Working Heads
For Deep Wells

Length of Stroke
5 to 24 inches

Size of Discharge
Up to 6 inches



PATENTED
APRIL 30TH, 1901,
No. 673,282.
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Bulldozer
Power Pumps
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Double Acting
Length of
Stroke
5 to 20 inches

Size of
Cylinders
2 1/2 to 6 inches

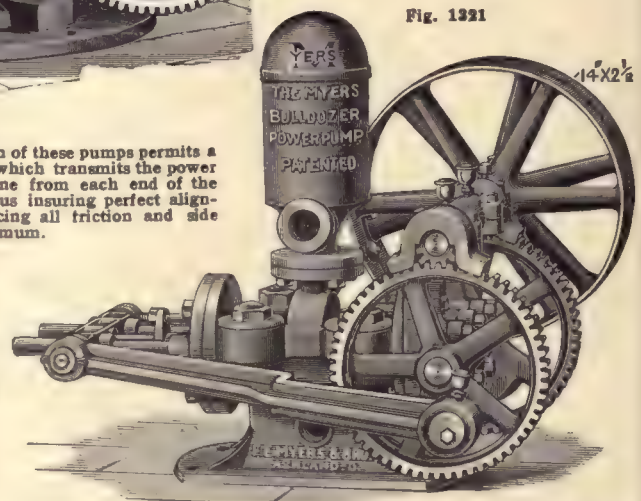
Size of
Discharge
Up to 4 inches

Capacities
600 to 7200 Gallons
per Hour

Fig. 1321

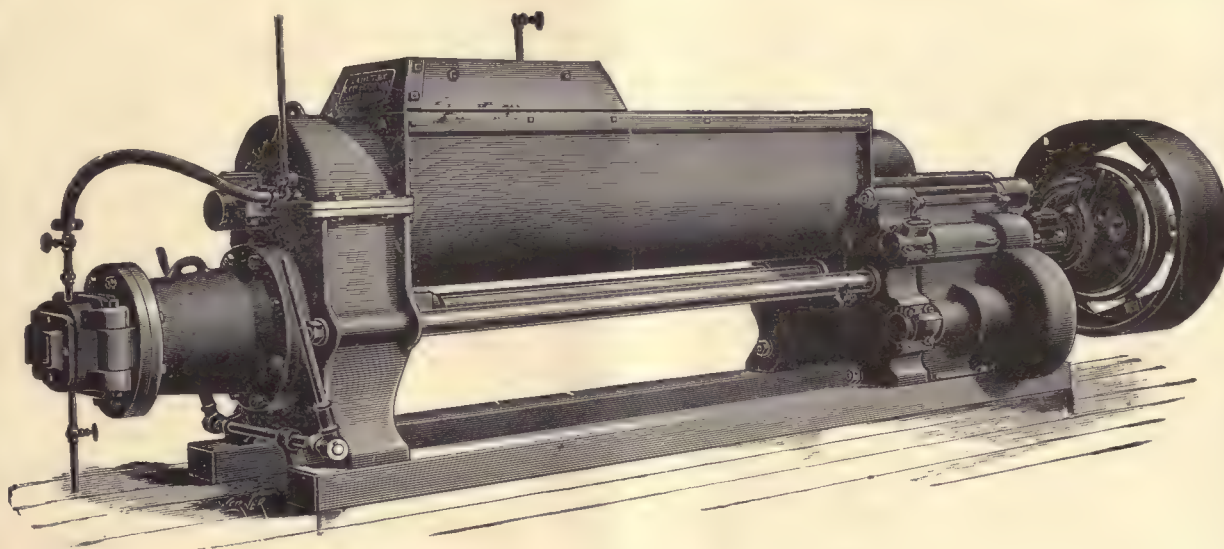
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ASHLAND PUMP AND HAY TOOL WORKS

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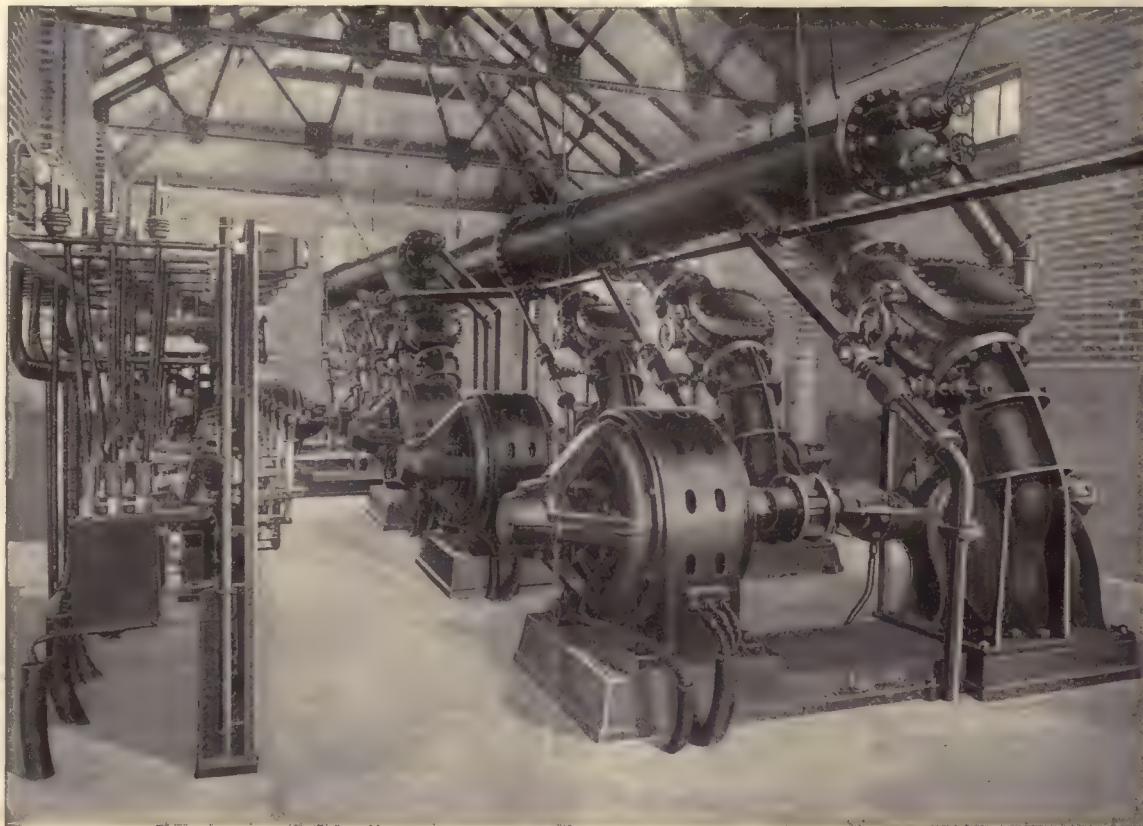


FIVE SIZES ALL CAPACITIES

Outfits for Drain Tile, Hollow Ware, Building
and Paving Brick and other Clay Products

If interested write us for particulars and estimates.

E. M. FREESE & CO.
GALION, OHIO



An installation of six 14-inch "American" Centrifugals installed by Payette-Oregon Slope Irrigation Company near Payette, Idaho, for irrigating 6,000 acres and delivering over 50,000,000 gallons of water per day on lifts of 84 and 110 feet.

Why More American Centrifugals Are Installed for Irrigation Pumping Than Any Other Make or Type of Pump

THEY not only represent the highest development of the centrifugal principle of pumping, combining low first cost with low attendance and repaid costs, and the highest efficiencies of this type of pump, but they possess distinctive features which make them superior to other centrifugals.

They are made in special designs to meet every possible condition instead of attempting to adapt all locations to a single style of pump, and they maintain their rated efficiencies.

The accompanying illustrations show three views of the irrigation installation of the Payette-Oregon Slope Irrigation Co. near Payette, Idaho. There are six 14-inch "American" centrifugals direct connected to electric motors which are employed to pump water from an intake from the Snake river to irrigate 6,000 acres of adjacent

bench lands. Pumps deliver water through two 36-inch pipe lines, three pumps delivering water into each line, one of which raises water through 500 feet of pipe 110 feet and the other line through 450 feet of pipe 84 feet.

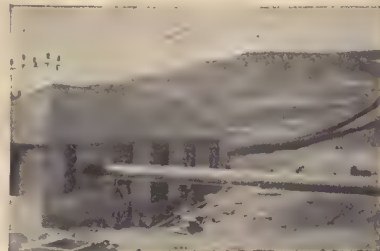
Each of the pumps deliver 5,000 gallons per minute when operated at a speed of 1160 R. P. M. but the important point is that the pumps were designed especially to meet the conditions and each pump shows a mechanical efficiency of 84 per cent and the overall efficiency of the entire plant is 74½ per cent.

Consider that this water contains a large amount of silt and grit, but due to the large, balanced, easy flow line passages, these efficiencies are not only initial ones but those the pumps maintain. No other type of pump will equal this economy under these conditions.

In nearly every irrigation pumping district in the West you will find "American" centrifugals showing greatest economy through their being better designed and especially adapted to meet the conditions under which they are installed.

American Centrifugal Catalog 117 is the most complete published. Write for it.

The American Well Works
General Office and Works, Aurora, Ill.
Chicago Office: First National Bank Building



THE IRRIGATION AGE

VOL. XXVII

TITLE REGISTERED U.S. PATENT OFFICE

NO. 11

CHICAGO, SEPTEMBER, 1912

Austin Combination Sloping or Vertical Bank Excavator



A double-acting machine that enables the contractor to take work away from competition because it lowers expenses and lowers bid figures. It will dig a tile ditch or sewer trench 2½ ft. wide, 10 ft. deep; and by substituting a bank-sloping attachment will dig sloping-side open ditches 5 ft. deep, 4 ft. bottom, 16 ft. top (or any dimensions smaller) at maximum rate of 9 lin. ft. a minute. And both ditches are finished; the tile ditch needs no hand labor—the open ditch has accurately-sloped, smooth, wear-proof banks.

*Send for Catalogue
No. 200*

F. C. Austin Drainage Excavator Company
Railway Exchange, Chicago, Ill.



Morris Machine Works

BALDWINVILLE, N. Y.

Centrifugal Pumping Machinery, designed for any irrigating or dredging proposition. Send details or specifications of what is wanted and we will recommend a pumping outfit to supply the need.

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D. H. ANDERSON, Publisher
CHICAGO, ILLINOIS

Myers Power Pumps

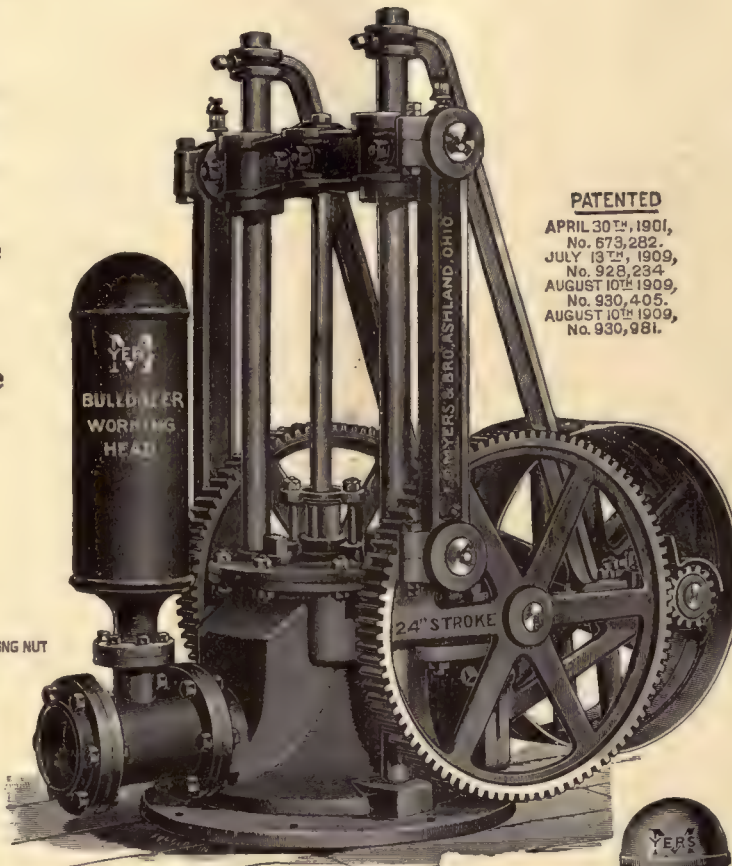
Working Heads, Pumping Jacks, Cylinders, Etc.

PATENTED

The Myers
Bulldozer Power
Working Heads
For Deep Wells

Length of Stroke
5 to 24 inches

Size of Discharge
Up to 6 inches



PATENTED
APRIL 30TH, 1901,
No. 673,282.
JULY 13TH, 1909,
No. 928,234.
AUGUST 10TH, 1909,
No. 930,405.
AUGUST 10TH, 1909,
No. 930,981.

PATENTED

The Myers
Bulldozer
Power Pumps
For
Shallow Wells

Double Acting
Length of
Stroke
5 to 20 inches

Size of
Cylinders
2 1/2 to 6 inches

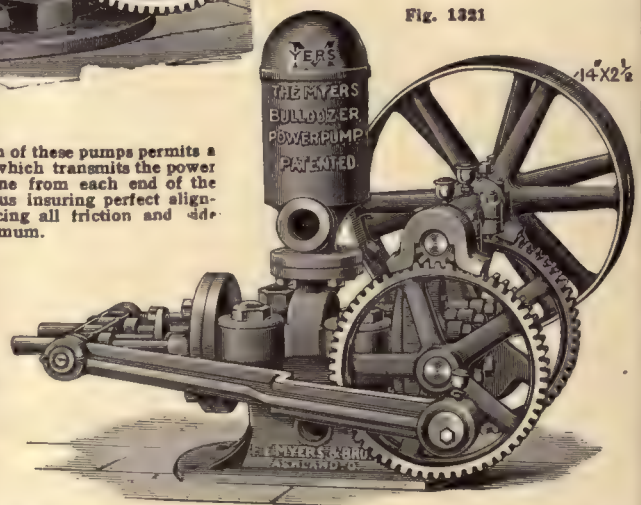
Size of
Discharge
Up to 4 inches

Capacities
600 to 7200 Gallons
per Hour

Fig. 1321

The construction of these pumps permits a double gearing which transmits the power in two lines—one from each end of the same shaft, thus insuring perfect alignment and reducing all friction and strain to a minimum.

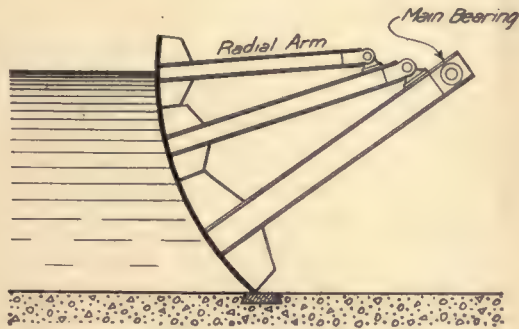
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Catalogue
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Prices



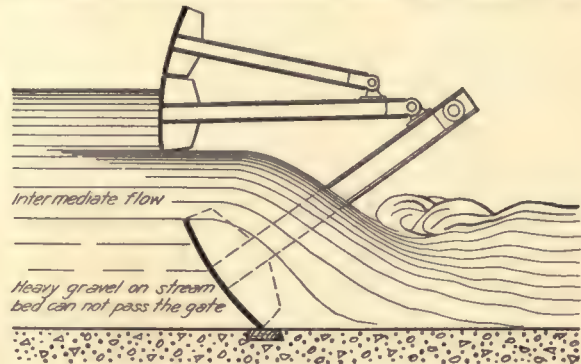
F. E. MYERS & BRO., ASHLAND, OHIO
ASHLAND PUMP AND HAY TOOL WORKS

THE HALL SEGMENTAL RADIAL GATE

For securing three-part control of water flow



GATE CLOSED

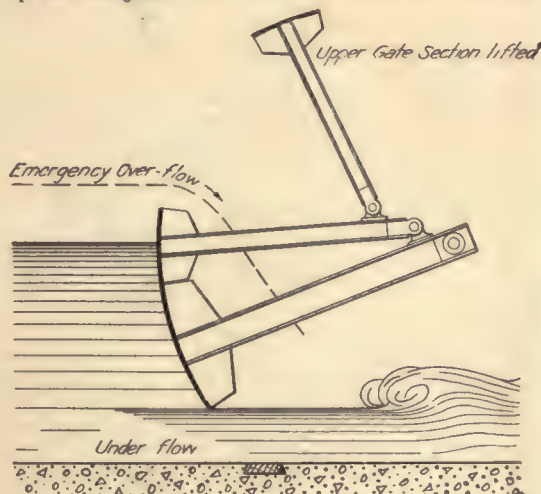


GATE RAISED FOR INTER-MEDIATE FLOW
(Head-gate example)

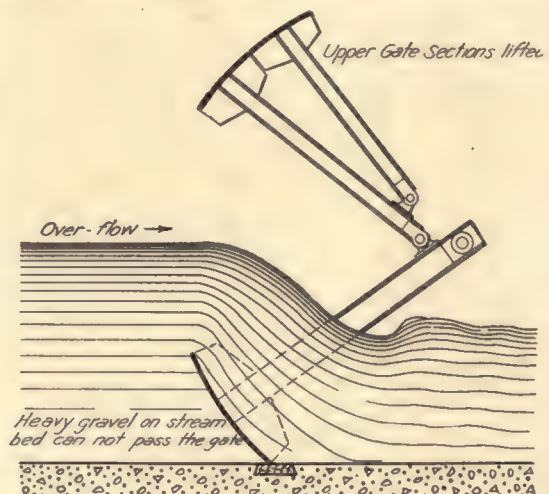
Our Circular describing the Hall Segmental Gate, which we will send on application, gives a clear understanding of this most admirable and practical device. For the first time the constantly recurring problem of the absolute control of diversion dams, main canals and lateral ditches is clearly solved. You will catch the basis idea instantly from the subjoined skeleton diagrams.

We call this "three-part regulation" because the problem always is to control surface flow (for trash) under flow (for silt and sand), simultaneously and yet independently, and at the same time maintain the upper lip in the proper position for safety spill, so that the canal may never be over-charged and a wash-out result.

Again, a diversion dam in connection with the canal head gates must always be able to reject the floating trash and sand at the intake and discharge them through the dam. Moreover, the pond above the diversion dam must neither be allowed to fill up, nor must the water level be lowered below the service point. Yet it must at the same time be controlled against sudden rises which would over-top the head gates.



GATE RAISED FOR UNDER-FLOW
(Waste-gate example)



GATE RAISED FOR OVER-FLOW
(Head-gate example)

This is a complex proposition and varies with every stage of flood. By the Hall Gate it is absolutely under control, no matter what the combination. The gates themselves scarcely cost more than the ordinary "Tainter" or "Drum" gate and are operated far more easily.

The same type of gate is equally applicable to control a reservoir level on the crest of a spillway. The various figures herein shown are to a certain extent self-explanatory—the Circular will be wholly so. Send for it. Respectfully submitted,

AMBURSEN HYDRAULIC CONSTRUCTION COMPANY, ENGINEER - CONSTRUCTORS
88 Pearl St., BOSTON, MASS.

NEWTON L. HALL, District Engineer, Colorado Bldg., DENVER, COLO.

No Other Pump Equals This Economy for Deep Well Water Works Installations

COMBINING in one pump the raising of water to the surface and producing automatically a uniform pressure in the mains in a design of pump that occupies small space and which can be located in any convenient position so that wells can be distributed throughout the waterworks system and each deliver water the shortest possible distance through the mains, necessitating only the adding of small mains to connect the pumps when a larger quantity of water is required instead of replacing the principal mains with pipe of larger size are some of the economies of the use of the

American Combination Deep Well Turbine and Booster Centrifugals

The accompanying illustration shows, in a general way, a pump of this type installed in the city water works at Rockford, Ill. As shown pump is completely equipped with gauges for making tests but the Rockford installation has only four turbine stages at bottom of well instead of six as illustrated.

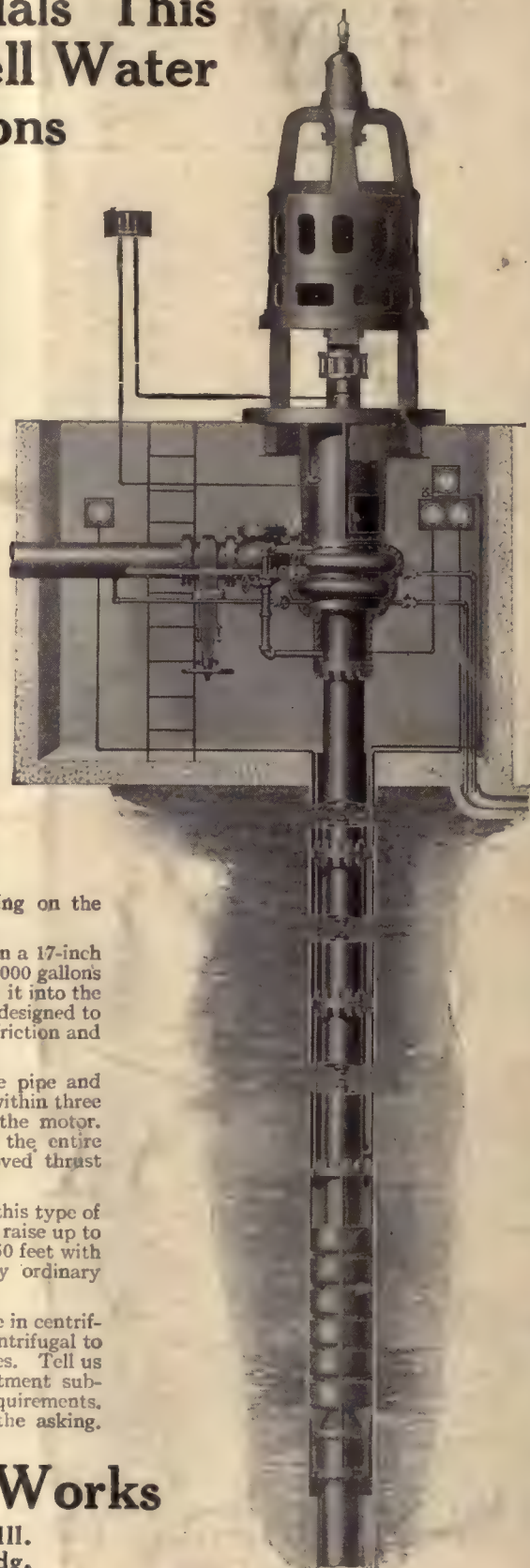
This combination consists of a multiple stage turbine at the bottom, or pumping level, in the well for raising water to the surface and a two stage vertical type centrifugal at the surface, operating on the same shaft, for producing a pressure in the mains.

The pump in the Rockford installation operates in a 17-inch drillhole, inside of well casing, and is designed to raise 1000 gallons of water per minute 134 feet to the surface and deliver it into the mains at 68 pounds pressure or, in other words, it is designed to operate against a total head of 302 feet, velocity, friction and hydrostatic heads included.

In this pump a check valve is placed in the discharge pipe and an automatic regulating device regulates the pressure within three pounds, this variation being sufficient to stop or start the motor. An important feature of this pump is the carrying of the entire weight of the shaft and attached impellers on an improved thrust bearing device at the surface.

A large number of highly successful installations of this type of turbine enables us to say that it is entirely practical to raise up to 3000 gallons of water per minute from depths down to 250 feet with this combination pump and deliver it against any ordinary domestic or fire pressure.

This is only another example of the advanced practice in centrifugal pump design which is proving the "American" centrifugal to be the most economical pump in a wide range of uses. Tell us your pumping conditions and let our engineering department submit a design which will be most economical for your requirements. Complete centrifugal catalog No. 117 mailed free for the asking.



The American Well Works

General Office and Works: Aurora, Ill.
Chicago Office: First Nat'l Bank Bldg.

THE IRRIGATION AGE

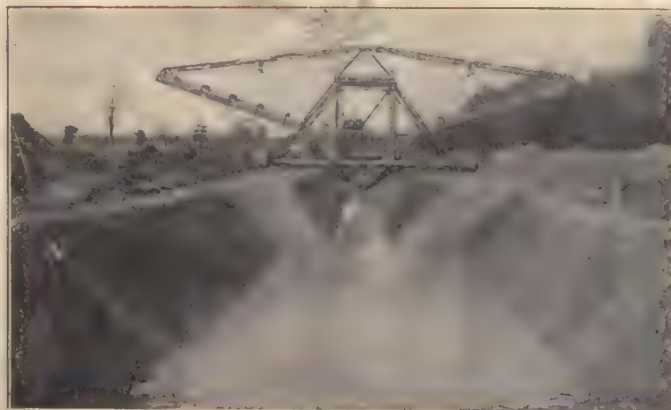
VOL. XXVII

TITLE REGISTERED U.S. PATENT OFFICE

No 12

CHICAGO, OCTOBER, 1912

Scientific Ditching Is Not Merely Moving Earth



Austin Drainage Excavator

Full Details in Catalog "S" and Special Circular No. 200

It is building a shapely, durable channel to carry water. Perfect alignment, grade and smoothness, sloped banks, and a clean berm of even width, all are essentials of a well-constructed ditch, and an **Austin Ditcher** guarantees them all. There is no other way of guaranteeing the same essentials except hand excavation at prohibitive cost.

F. C. Austin Drainage Excavator Company

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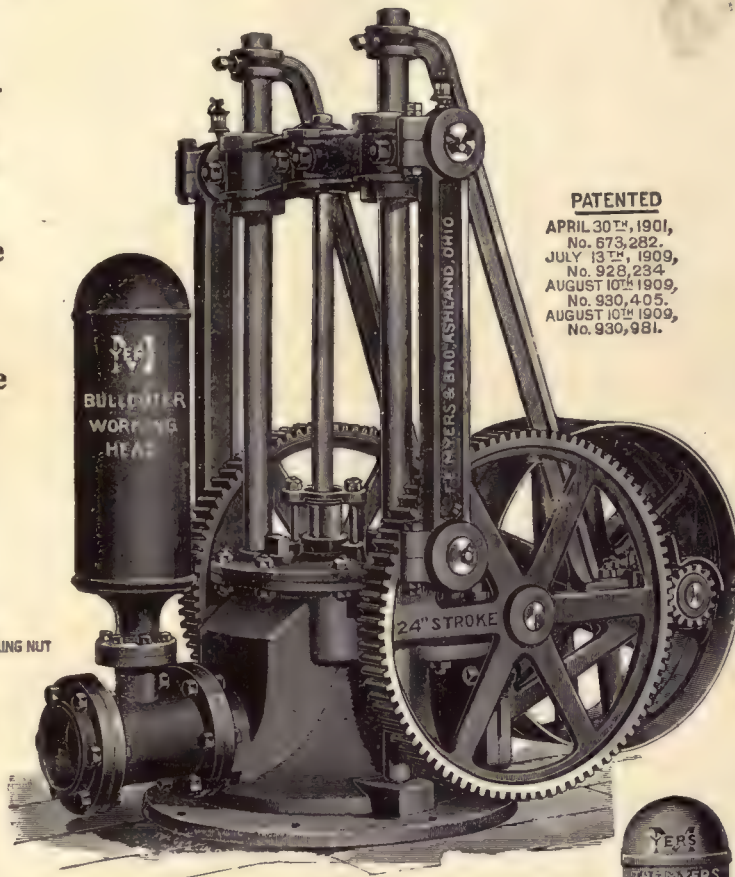
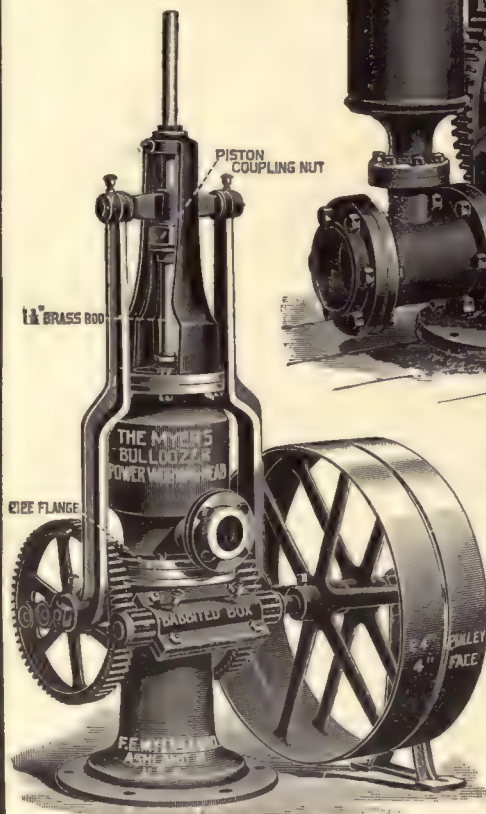
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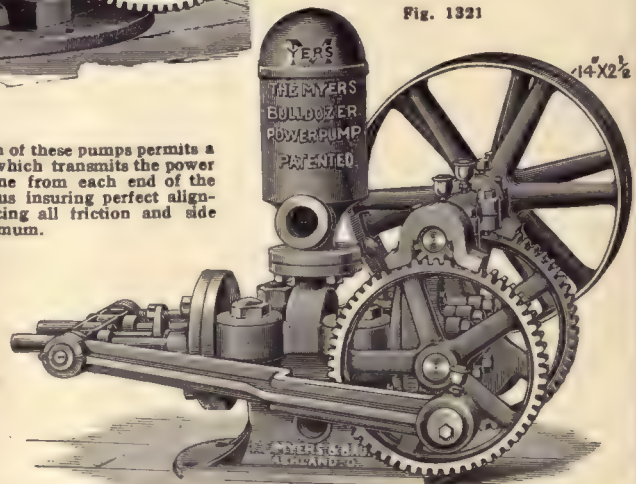
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per Hour

Fig. 1321



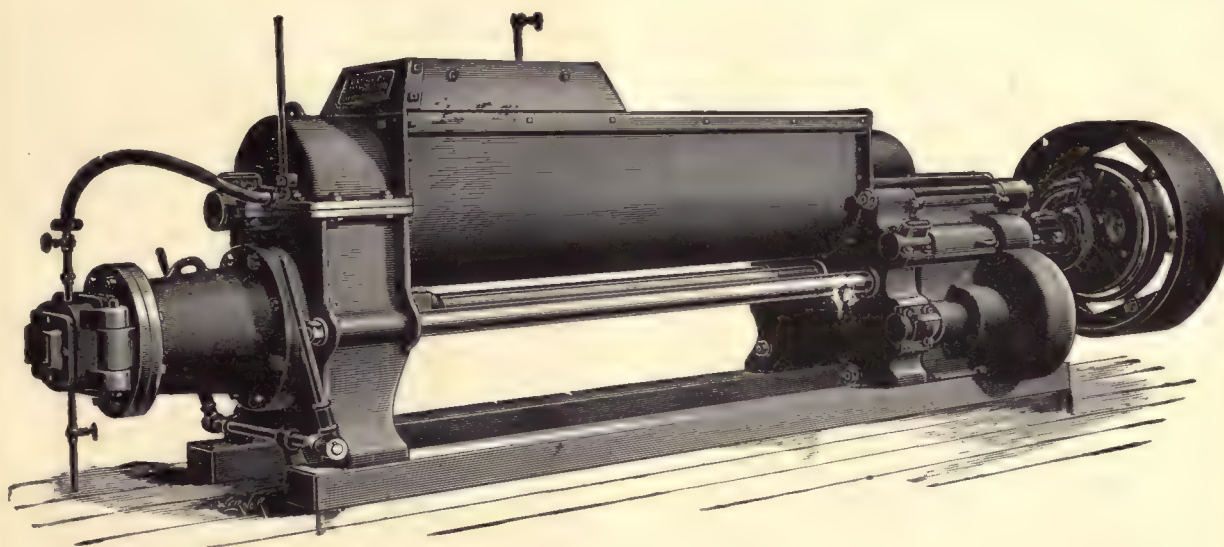
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American Combination Deep Well Turbine and Booster Centrifugals

The accompanying illustration shows, in a general way, a pump of this type installed in the city water works at Rockford, Ill. As shown pump is completely equipped with gauges for making tests but the Rockford installation has only four turbine stages at bottom of well instead of six as illustrated.

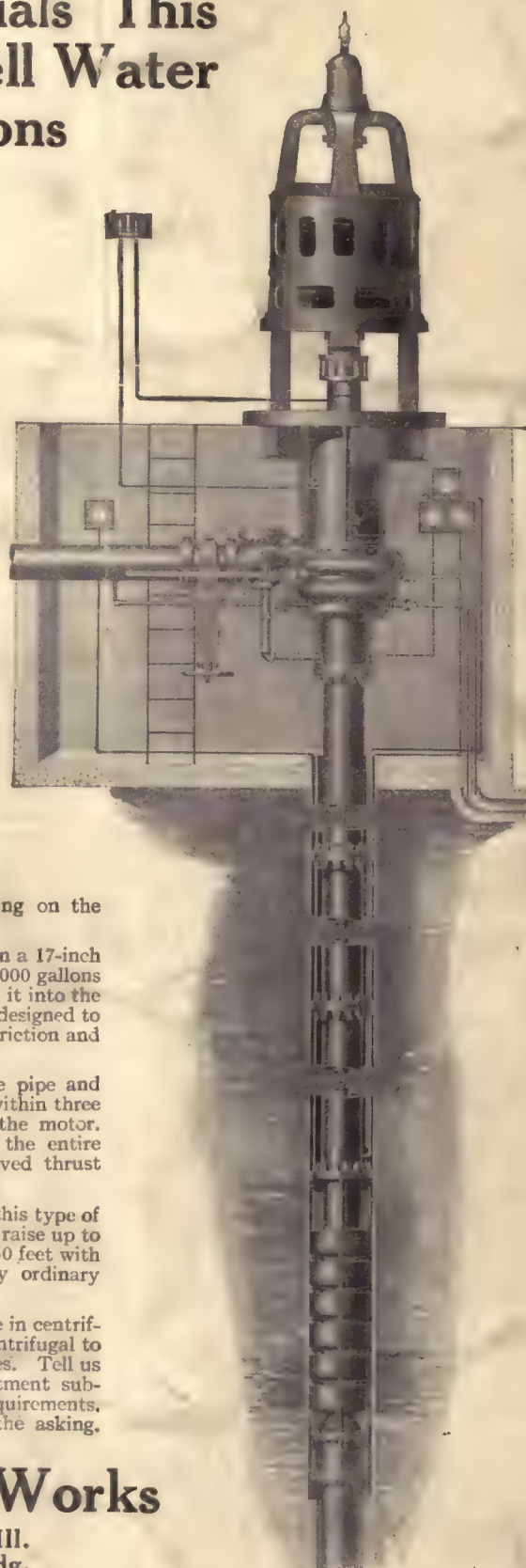
This combination consists of a multiple stage turbine at the bottom, or pumping level, in the well for raising water to the surface and a two stage vertical type centrifugal at the surface, operating on the same shaft, for producing a pressure in the mains.

The pump in the Rockford installation operates in a 17-inch drillhole, inside of well casing, and is designed to raise 1000 gallons of water per minute 134 feet to the surface and deliver it into the mains at 68 pounds pressure or, in other words, it is designed to operate against a total head of 302 feet, velocity, friction and hydrostatic heads included.

In this pump a check valve is placed in the discharge pipe and an automatic regulating device regulates the pressure within three pounds, this variation being sufficient to stop or start the motor. An important feature of this pump is the carrying of the entire weight of the shaft and attached impellers on an improved thrust bearing device at the surface.

A large number of highly successful installations of this type of turbine enables us to say that it is entirely practical to raise up to 3000 gallons of water per minute from depths down to 250 feet with this combination pump and deliver it against any ordinary domestic or fire pressure.

This is only another example of the advanced practice in centrifugal pump design which is proving the "American" centrifugal to be the most economical pump in a wide range of uses. Tell us your pumping conditions and let our engineering department submit a design which will be most economical for your requirements. Complete centrifugal catalog No. 117 mailed free for the asking.



The American Well Works

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